THE WORLD AS A LEARNING ENVIRONMENT

playful and creative use of GPS and mobile technology in education

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CONTENTS

INTRODUCTION

Education is changing. Formerly, a school's education used to last pupils a lifetime, but today life-long learning is a key issue. Pupils are being educated to work and live in the society of the future. This society requires innovating and creative behaviour instead of standard skills and the reproduction of facts. Today knowledge is not the goal; it is a tool.

This situation presupposes new competencies in teachers that allows them to be adaptive. New media and technological developments support and stimulate the development of talent and competencies in pupils and teachers alike. It is therefore important that both pupils and teachers are in the know of the often innovative possibilities which new media and creative technologies have to offer.

These changes require different forms of education. Pupils are no longer positioned in rows in the classroom to listen to the teacher, in order to subsequently learn by heart what he or she told them. These days classrooms are filled with groups of students who set to work guided by their teacher. ICT is playing an ever more important role here: it is difficult to image studying without a computer.

The computer has become part of the current Dutch education. Slowly but surely an increasing number of developments in ICT are entering the classroom. Some of these developments are the use of Internet and learning through games, media applications and mobile devices such as mobile phones, PDAs and laptops.

In view of the changes in education it is quite probable that games and mobile technologies are going to play an ever more important role in the classroom practice. They may even have to play an important role, in order to meet the current changes. Learning does not necessarily have to take place in the classroom. With the latest developments in technology it can also take place outdoors. The direct environment of the school and of the pupils is then used for learning in authentic contexts.

In this publication we will discuss what learning with the use of mobile technologies, positioning technology (GPS) and game-based learning can mean for education. We will see which learning methods are possible and why they can be useful. After this theoretical assessment we will present some of the learning methods that have recently been developed by examples from actual practice. The project descriptions discuss the experiences of both pupils and teachers. We will read about their experiences when not just pupils' classrooms, but also their direct environment acts as a playing field as well as a learning environment. The descriptions also indicate how the project designers follow up on the experiences of pupils and teachers.

A reflection follows the description of the examples of actual practice, comprising the most important conclusions from the examples and focusing on the added value of mobile and location-sensitive technology in learning, the focal aspects for each target group, goal, learning method and the role of the teacher.

THEORETICAL CONTEXT

Mobile technology has become an essential and indispensable part of our world. Telephones, PDAs and other media applications fit into our pockets. They enable us to contact other people anytime, anywhere. The possibilities for communication are very diverse. Even access to sources is possible via mobile technology. Educational developers and the education community are now studying how to deploy this wealth of media experience to stimulate and promote learning. And learning can take place both inside and outside the classroom.

Mobile learning

The term mobile learning was coined as a specification of E-learning. E-learning is the generic term for learning with the use of ICT. Mobile learning uses either wireless equipment, such as laptops, mobile phones, tablet PCs, PDAs, or smartphones. The term 'mobile' indicates that the device is portable and can be moved.

Broadly speaking mobile learning can be taken to mean three things: learning with mobile devices, the learning person who is mobile (whether or not using a device) and mobile content or sources – which can be accessed from anywhere. In mobile learning location-specific learning (or non-location-specific learning) plays an important part.

Location-based learning using GPS

The use of orientation technology or GPS (Global Positioning System) can add an additional dimension to mobile learning. New possibilities emerge when a pupil starts learning with a mobile device with GPS functionality. Via satellites the GPS receives signals that indicate the position of the pupil with the device. On the basis of this position the pupils can receive location-specific information on their devices, or add this information. In this manner a connection will be formed between the physical and the virtual worlds in which the pupils find themselves; several layers of information are accessible at the same time.

GPS allows the pupil to turn this learning-in-an-authentic-context into a personal experience, and to share this experience with others.
A major development is the fact that not only devices like telephones and computers are becoming increasingly mobile; this also holds for the Internet itself. The internet is a platform for information, encounters and expression. It is quickly finding its way into the public space. This means that everyone can be online anytime, anywhere. Mobile devices are being used to produce, communicate and share.

GPS is also increasingly used in the leisure sector, for instance in the form of citygames and GPS walks. These applications were not developed for education, but there is usually an educational element to them.

Game-based learning

Gaming elements are often added to the learning process in order to turn learning on location into a social and motivating learning method. Many educational GPS applications make use of gaming principles from videogames, board games and outdoor games. These gaming principles can motivate pupils and increase their perception of the learning content.

Research has shown that games challenge pupils. They also stimulate the imagination and curiosity. Playing games together has a positive effect on pupils' social skills. It can also contribute to gaining insight into processes that are difficult to fathom. Learning with the use of games is also called game-based learning.

As yet there is no unambiguous definition for games. Certain elements that are often considered essential parts of a game are:

- A goal that the player needs to achieve
- Competition (playing against the computer, a co-player or oneself, with scores)
- Obstacles that need to be overcom
- Rules that are to be observed
- A specific context
- Being able to experiment with various characters/ roles

A number of gaming principles are often applied in education and combined with other learning methods. What is central here is not learning through an existing (video) game, but rather increasing the pupils' motivation and involvement and their perception of learning content. The application and translation of certain gaming principles into an educational learning method is a means to achieve this goal.

Educational context

There are various learning theories in education and in science. Which learning theories are considered to be mainstream is partially dependent on the prevailing perspective in education. 'Het nieuwe leren' (New Learning) was introduced in the Netherlands some time ago, a new perspective of learning. This perspective favours adequate behaviour over ready knowledge.

Constructivism is an important learning theory in New Learning. Learning is seen as an active process of knowledge construction instead of knowledge absorption. Social processes are of interest here. Instruction supports the construction of knowledge, instead of dictating it. Some constructivists emphasize the social construction of knowledge, hence they speak of social constructivism, in which collaborative learning is an important process.

The interest in authentic learning stems from constructivism. Authentic learning is aimed mainly at the real world, complex problems and the corresponding solutions. It uses learning methods such as role-playing, problem-based activities, case studies and participation in (virtual) learning communities. With this method of learning it is important that transfer takes place; pupils need to know how to apply their newly gained knowledge to another kind of problem. The idea behind learning on authentic locations is that pupils need to put in less effort to translate the subject matter to the situation-specific context in which they need to apply what they have learned.

Mobile learning and learning with the use of games can help learning in an authentic location, or help creating an authentic location. The 'real' and the virtual worlds can sometimes be combined in a game. In such a game tangible objects and information from the 'real' world come together with computer generated data. This so-called Augmented Reality leads to new forms of knowledge transfer and perception.

When we ask ourselves what added value mobile technologies and games provide to education, we should

photo: SURFnet|Kennisnet Innovation programme

not focus on the technological possibilities, but on the new activities that are made possible. Being mobile has added a new dimension to learning through technology or computers; because of the personal and portable nature of the applications and because of the interaction this allows with other people and with the surroundings. It is important to look beyond the use of individual devices by individual users in order to appreciate the full potential of mobile technologies for learning.

Possibilities and pitfalls

Why should we apply mobile learning, whether or not using games and GPS, in education? The teachers who are already working with mobile technologies have multiple reasons to apply them. Being able to communicate with others at will at any moment, finding information, taking pictures and making clips and sharing with others is what most people have become used to. This goes especially for pupils of the 'digital generation'. The latest developments in mobile telephony and technology show what can be achieved in the field of augmented multimedial experiences and location-specific information.

There are many advantages to working with mobile technologies. Time and location independent learning, faster communication and access to various sources are the most obvious advantages. Another often mentioned advantage is being able to experiment with scenarios and simulations which are impossible in real life, but which can be simulated in an authentic context. It is safe to experiment with them, as mistakes will only affect the simulated environment.
When a GPS is added, location-specific learning becomes possible: assignments, stories and media can be linked to a specific location. Perception is intensified and the subject content is given a more direct context. The scope of this booklet does not allow a full discussion of all the advantages, but a number will present themselves in the examples detailed below.

Mobile and game-based learning can be a fun and valuable way of learning, on condition of a well-considered implementation. Major considerations are: "Why am I implementing this way of teaching?" and "Is this the best way for the pupil to achieve his or her learning goals, or are there better ways?" Keep an eye on the goals you wish to achieve. You can also choose to implement this way of teaching in order to experiment with mobile and game-based learning. This is a valid consideration, but in that case do not set yourself too many other goals.

Once the choice for mobile or location-based learning has been made, it is important to realise what is needed, to know who is responsible for what, and to have a good look at the preconditions. Preconditions are for example the required technologies and know-how. Mobile learning does not need to be isolated; it can be combined with other working methods just fine. A game outside the school can be combined with a discussion of a digital assignment in the classroom. Certain games can have low learning benefits by themselves, but when combined with other learning methods they may be very instructive. For this reason the role of the teacher is very important, as it is the teacher who decides how the learning goals are best achieved.

Once the learning goal and the usefulness of the use of a game are clear, there are still a number of critical factors that influence the implementation in daily education. Renting or buying technology involves costs. This can be an obstacle for teachers who wish to work with mobile technology or join an existing project (for instance a project from this booklet), as not every school has a budget available for purchasing PDAs, mobile phones or other technologies. Some projects allow for hardware to be rented or loaned.
If there is a budget, it can be problematic to find the right equipment or technology; though there are many mobile devices on the market, as well as great games, they are not always compatible. There will probably be less problems in this area in the future. As a teacher you are advised to familiarise yourself with the current possibilities and expectations for the future.
Finally embedding the use of mobile technologies in the curriculum can be a problem. This requires an

adaptive attitude from a teacher as far as the existing applications are concerned. Alternatively a teacher may need to spend a part of his or her time and energy (perhaps with the pupils) to create a game that is in line with the curriculum.

In short:

If handled properly, learning using mobile technology can be a very valuable and stimulating form of learning. The various examples discussed in this publication illustrate this point.

EXAMPLES

music
creating games
GPS
opera
singing trails in the city

DE ZINGENDE STAD

foto: Anna van Kooij

Description

Yo! Opera enables pupils to map their environment vocally with De Zingende Stad (the singing city). This is achieved by combining music lessons with location-based learning. De Zingende Stad aims to motivate and stimulate pupils and teachers to sing. It is implemented using Games Atelier. Games Atelier has been developed for secondary education, but De Zingende Stad has geared the software for use in primary education. A curriculum is being developed for groups five through eight (ages 9 to 12). Teachers can use the curriculum for music, topography, ICT classes, social surroundings education, etc.

The lessons offer pupils basic musical knowledge (on timbre, volume, tone, rhythm) and breathing and listening exercises. These lessons are combined with location-based learning near the school. Songs and sounds are linked with the pupils' direct surroundings. The pupils learn songs about the schoolyard and the area around the schoolyard. In the higher grades the pupils themselves will start to write the songs and set them to music. Within each year the pupils create a musical quest or game using the Games Atelier software. Creating these quests or games allows the pupils to creatively transform their knowledge about the area into music. The games they create are played by the other pupils in their year, by parents and other interested parties.

Experiences

The project, De Zingende Stad, has been underway since May 2008. For this reason we can only discuss results from group five in primary education at the moment of writing this booklet. These pupils have mapped their surroundings vocally, by assigning sounds to all sorts of living and lifeless objects in their surroundings. From waste bins to aeroplanes, everything was given a sound. Music lessons were combined with learning how to read a map. First the pupils learnt how to read the map of their class-

photo: Debora Patty

room, then the school map and later a map of the area around the school. Finally they learnt how to use 'google maps'.
In six lessons the pupils created a musical quest which could be played using mobile phones. The pupils then played one another's games. During the quest the players are provided with all kinds of sounds, and at certain locations they are given the assignment to sing a song. The team that performs best on the assignments is the winner.
The group five pupils were well able to play the quest with the mobile phones. It transpired that pupils were by now able to read maps and to navigate. When the pupils went the wrong way they could see on the mobiles that they were moving away from the location of their assignment. In this manner the pupils were able to correct themselves. They really liked the alternation between the music lessons and the lessons on reading maps and navigating. While they were singing they had learned how to read a map without realising it.

Creating assignments was too challenging for some. They had difficulties putting themselves into the position of the pupil who was going to play their game and came up with questions or assignments that were impossible for the players to solve or complete. The level of difficulty of the assignment will be adapted for these groups.

The group five pupils thought the mobile phones were cool and exciting. This had a great impact on the lessons. It was striking that the boys were singing more than usual. The pupils felt free to address people in the street and subsequently sing together with them. By involving their own surroundings their learning became a personal experience. The pupils regularly recounted their experiences in certain locations on their route.
The 'musical assignments' that are linked to the locations in the area created new landmarks. For this reason the pupils now have a different view of the area. Working with new media seems to facilitate singing. The game-like setup makes it look like singing is not the primary goal, but an activity that is required in order to play the game. This is immersion: to be engrossed in the team gameplay such that assignments (like singing) are carried out without much conscious thought.

In a project such as De Zingende Stad the children feel much freer to express themselves than usual. Because they are so engrossed in the game they show much more daring than in a regular context. The boldness they show in their game (which they find surprising as well) may be expected to contribute to their general self-confidence. From September it will be the turn of groups six, seven and eight. More will be expected from them in term of musical parameters. Moreover the pupils will be involved in creating a game instead of a quest, for which they will formulate storylines and gaming strategies.

FACTS & FIGURES

Website: www.dezingendestad.nl
Developed by: Yo! Opera, Waag Society, OBS De Rietendakschool
Year: 2008
Target group: Primary ed.
Technology used:
> Hardware: mobile phones, music recording equipment (mp3)
> Software: Games Atelier

scout
autonomous collaboration
primary education
active
exploring

LOPEND LEREN

photo: Raymond Trippe

Description

'De Verkenner' (the Scout), a PDA with GPS, takes pride of place in the Lopend Leren (learning on foot) project. Primary school pupils use the Scout as a learning aid. Lopend Leren aims to promote active and autonomous learning both on and off the school premises. Children can use their Scouts to record sounds, to surf the Internet and to exchange files. The Scout includes PowerPoint, Excel and Word. GPS is used for projects ouside the school, for instance when they take a walk through the area and complete assignments.

Each pupil has his or her own PDA, but collaboration is an essential part in the project. The Scout has been deployed in four schools in the first pilot of this research project. At one of these schools group three children (age 6) used the device to create a digital letter book. Using the PDA they were asked to find pictures and sounds for each letter. They subsequently made a collage. Initially the idea was to have a digital camera on each PDA, but this proved too costly. For this reason the PDA was used in combination with a separate digital camera. This turned out well, as it forced the children to divide tasks within their separate groups.

Experiences

Its multiple possibilities make the Scout a very flexible aid in the various teaching programmes in primary education. One of the participating schools has a very flexible curriculum, of which the PDA has become part and parcel. When a pupil's interest is caught by an item during the weekend, he or she can take a picture and find out more about it later at school. There are schools with a more fixed curriculum. It takes a little more effort to fit the PDA into their teaching programme, but many applications come to mind.

The results of the one year pilot are positive: Lopend Leren leads to collaboration and autonomous learning. Moreover the pupils can combine the newfound data into new knowledge.
The pupils greatly enjoyed the use of the PDA. It allowed them to work autonomously, and when things were not clear they helped each-other. Adding the GPS turned out to have added value. When investigating a building or walking a route the pupils are highly motivated, and assignments are carried out with great devotion.

Teachers involved were also enthusiastic about the lessons involving the PDA, though some had difficulties imagining how to deploy the PDA in their lessons. The use of the PDA requires some training. The pupils usually were very quick to find out how the device worked. It sometimes happened that the pupils showed the teachers how the PDA works. If PDAs are to remain deployed in education it is essential to have good training programmes for teachers. It is important that in a school a single person is responsible for the use of PDAs who will motivate the others. As a result of the pilot an investigation was launched into the question whether this type of assignment induces deeper learning (as opposed to surface learning). In DoorLopend Leren (continuous learning), a newly launched project, the use and the implementation of the application is developed and tested further. Among other things a new interface is developed which will be very easy to use. The aim is to for teachers to be able to work with the PDA within a few hours. A series of assignments for the PDA is being developed as well which children will be able to carry out both inside and outside the school.

FACTS & FIGURES

Website: www.lopendleren.nl
Developed by: AB-ZHW,
with support from Kennisrotonde
Year: 2007/2008
Target group: Primary ed.
Technology used:
> Hardware: PDA
> Software: Microsoft mobile,
Red Halo,
application: Nieuwe dingen doen

GPS
outdoor learning
multi-disciplinary
mobile learning
content developed by users

CREATE-A-SCAPE: SAVANNAH

Description

Create-a-Scape can be used to link data to locations by both pupils and teachers. This allows them to create walks, games or fantasyscapes that other people can subsequently experience. This is called a mediascape: a collection of location-bound images, texts and sounds that become a layer over the real world.

Create-a-Scape has been used since 2006 by various schools in primary and secondary education in England. It is suited for various learning methods: it can be used in pairs or by the whole class. It is the users who add the content. This makes it very flexible to incorporate in the curriculum, and allows it to serve various learning purposes. Create-a-Scape aims to contribute to the development of creative and collaborative skills of both pupils and teachers. Moreover it improves pupils' awareness and perception of specific locations.

An example of a game created with Create-a-Scape is 'Savannah'. In this game a primary school schoolyard was changed into a virtual African savannah. The mediascape had been created in advance by the teacher using a computer. The pupils were given a PDA that showed the savannah. In it they were given the task to survive as lions: learning how to hunt, seek a prey, and look after their cubs.

The Create-a-Scape website shows numerous inspiring examples of projects. Users can download all the required software, manuals and planning tools.

Experiences

A number of pilots were held on primary and secondary schools before Create-a-Scape became publicly accessible. The software was improved on the basis of the evaluations. 130 users have registered since the launch of the Create-a-Scape website in 2007. Pupils and teachers alike responded with great enthusiasm. Teachers indicated that they considered it good support of the learning process. Some teachers said the pilot reminded them of why they had chosen to work in education. Pupils especially liked collecting the content and creating the stories.

An independent team consisting of researchers from four British universities undertook a study in 2007 into the learning effects of Create-a-Scape. Projects in five schools were studied, and questionnaires were held among teachers, teachers' teachers and PhD students. The study investigated the added value of the application in education for pupils and teachers. A very important finding was that Create-a-Scape has a very positive effect on the involvement and motivation of the pupils.

Moreover a major plus is the possibility of linking audio and visual material to a loca-

tion. This enhances the creativity of users, and allows them to practice collaborating and communicating in a group.

FACTS & FIGURES

Website: www.createascape.org.uk
Developed by: Futurelab
Year: 2006
Target group: Primary ed., Secondary ed., various
Technology used:
> Hardware: PDA with GPS, laptop
> Software: Create-a-scape software, Mscape authoring tool

environmental education

seeing, hearing, smelling and feeling exploring adventure game

VEENQUEST

Description

Veenquest is an adventure game in which children explore the environment using a PDA with GPS. It aims to let children experience a nature reserve in their own way and to instil environmental awareness in them. The pupils set off autonomously with a PDA, while the teacher remains at the visitor centre. A map and a number of navigation tools indicate where they are supposed to go. When the groups come near an assignment, they receive an animation or an assignment. The players play the role of a journalist (for the Veenbode newspaper) who needs to solve an environmental problem. The problem is presented in a playful manner. The pupils help a stranded alien from outer space. Pupils complete assignments related to environmental education. Each completed assignment provides the alien with another spare parts for its crashed rocket. In the end the paper's chief editor has gained enough (educational) information to help the alien return to its planet. This is the end of the route; the pupils have returned to the visitor centre.

Experiences

The application was tested in 2007 and has been used since 2008. The results of the user tests are promising. Children thoroughly enjoy learning in this manner. The use of a PDA has a positive effect on them. They stayed focused during the pilot. They enjoyed setting off with the device, without a teacher. The content of the assignments was also graded very positive. The interface was enhanced and retested based on the user tests.
Teachers were very positive as well: "This makes a change from the old-fashioned pen-and-paper questionnaire." They thought that especially the combination of questions and a storyline was an excellent

means of keeping the children focused. It is important for the implementation of this quest in education that the schools have a good look at whether it is geared to their courses, as the curriculums of primary schools differ.

Children can currently play the game at the visitor centre in Eernewoude (Friesland) in the De Alde Feanen National Park. The development of a Frisian version has been planned, as well as new content aimed at culture. By mid-2008 work will start to adapt the technology to allow for competition and collaboration.

FACTS & FIGURES

Website: www.veenquest.com
Developed by: Hogeschool Leeuwarden, lectoraat ICT en veranderende didactiek (lector J.Lepeltak) and IVN Leeuwarden
Year: 2007
Target group: Primary ed., ages 8 - 13
Technology used:
> Hardware: PDA with GPS/GSM
> Software: KeurICT application, running on Windows Mobile

mobile
simulations
locative, GPS
climate change
politics and policy, voting
outside
role-playing, game

TIMELAB 2100

Description

TimeLab 2100 has been designed for school groups visiting the campus of MIT (Massachusetts Institute of Technology). The game aims to let pupils become familiar with the surroundings of MIT and with a number of science disciplines that are taught there through play. Though TimeLab can also be played as a separate extracurricular activity, some schools play the game as part of their curriculum.

The subject of the game is climate change and its effects on the pupils' direct surroundings. At the outset of the game pupils are provided with the following information:

"It is the year 2100 and the TimeLab needs your help. Climate change has hit hard on Cambridge, Massachusetts (where the game is played), and the rest of the world. The researchers at TimeLab have determined that a number of laws from 2008, implemented after an election, may have determined the course of history. Your aim is to study the effects of these various laws and to change the 2008 legislation through a new election".

The pupils then set off. While they are walking outdoors their route can be traced on a digital game map using GPS. Game locations are indicated as icons on the map. When they reach a game location, the PDAs provide information on one of the potential 17 laws that can be changed by the players, which is related to their current location. This information is provided to the pupils in text and pictures, among other things, from the narrative perspective of a virtual character. He or she may discuss the impact of public transport at a bus stop, for example, or alternatives in sustainable energy at a utility pole, or the future scenario of the flooding of the river that the pupil is following and the extinction of the water birds

due to the climate change.
This type of scenario makes the players consider two aspects of each potential law during the game: the impact of the law on climate change (low, medium, high) and its popularity (low, medium, high). These two aspects together influence the success rate of a law after a new election.
When the players return from their outdoor walk they each debate five laws they would like to change. They present this in short pitches to their classmates. Once everyone has had their say, the group determines which laws are nominated in a joint discussion. The pupils can subsequently put 3 post-its each on the laws that they consider the most important. Using a die they then play a game of chance in which the score decides whether the law makes it through the election. If the law goes through, the scenario that results from its implementation is read out loud. These scenarios show the various influences on climate change.

Experiences

TimeLab was played for the first time in 2008 as part of the Cambridge Science Festival. This festival aims to involve people actively in activities in the natural sciences. During the pilot 20 participants played the game over 3.5 hours. Teams consisted of a pupil (ages 10–14) and an adult. They were given a PDA at their disposal and together they went on a mobile investigation on the campus. The technology functioned well. In the game setup it transpired that the teams wanted to do the field research at their own speed rather than stick together as a group. They enjoyed it the most when they chose their own path at their own speed. It also transpired that players wanted to be challenged more in terms of game play and in collaboration / competition. The players appreciated both the outdoor assignment, especially due to the added GPS, and the group discussions indoors. They even asked for more time for the debate and for discussing the laws. Some also requested more academic facts and information on the content of the storyline: climate change and its future effects.
The story with its future theme was popular, but with some players, especially young ones, it led to confusion. This confusion concerned the moment in time that an animation or object on location was referring to: Did it concern the now, or the future? This has been taken into account in the questions and formulations of these stories. The game is also assigned different roles, which means that players need one another in order to arrive at a total overview of potential laws and scenarios. To enhance the interaction and the relation with the direct surroundings 'real' objects have now been added to the game, such as codes hidden in the grass that need to be cracked and used to open something.

A future development will be to offer two versions of the game. The versions are geared to the level of the target group: one to young children (10-14) and one for highschool students and older.
Finally, MIT will release the technological platform on which TimeLab has been developed from the end of 2008, in order to allow teachers and other interested parties to create such mobile games themselves.

FACTS & FIGURES

Website: education.mit.edu/drupal/ar
Developed by: MIT Scheller Teacher Education programme
Year: 2008
Target group: Primary ed., Secondary ed.
Technology used:
> Hardware: PDA with GPS
> Software: STEPS, online platform Developed by MIT, released for the public from the end of 2008

creativity
the city as a source of inspiration
multimedia experience
MP3
peer-education
working at your own pace
soundtrack
autonomous

SOUNDWALK

Description

A Soundwalk is a workshop consisting of walking a route, listening to a story and creating video materials. The workshop is offered in the contexts of art and cultural education, project education, introduction weeks and excursions. The goal of the Soundwalk is to make students see their city with new eyes. Their experiences are detailed in individual assignments, in which they use various (new) media.
In the first part of the workshop students are given an MP3 player, which runs a soundtrack with the story of virtual location scout named Foxy: "Foxy takes you through Rotterdam, in search of exciting movie locations for Vinnie's movie. Vinnie is a movie director shooting a film, 'The Real Deal'. He tells his story while looking for suitable locations."

The route is divided into different tracks and locations. The participants walk the route and listen to the story. En route they take pictures or movie shots, inspired by what they see and hear.
In the second part of the workshop the students in pairs create a movie trailer of a movie poster consisting of their own recordings. Students work autonomously with the computer programmes, editing their digital materials. They do so using specially developed software tools under the supervision of workshop leaders. The workshops are concluded by showing the results on a big screen and publishing the assignments on the Internet.

Experiences

The Soundwalk has been in use since the 2007-2008 school year. The first participating classes functioned as test groups. Before then the Soundwalk had been tested by the developers themselves and by the workshop leaders of Digital Playground. It was decided not to use GPS technology due to technological dependencies and costs. Instead a soundtrack was developed with timed references to the locations that students are walking past. This still gives students the sense of the here and now, and an augmented location experience.

The Soundwalk met the expectations during the pilot. The Soundwalk has a great deal of atmosphere; it grabs you and immerses you. The aim of the project is to make students look at their surroundings with different eyes and an augmented perspective, and it turns out that the project is indeed experienced that way by the students. The Soundwalk has multiple storylines, which proved complicated for vmbo (preparatory vocational education) students. Moreover it transpires in practice that some participants cannot process all the information. They hear the Soundwalk, the storyline and all sound effects, but when walking in the city they are also exposed to many stimuli. The impact of the audio input was overrated. Evidently the participants can be stimulated better with visual input. The route of the Soundwalk proved too long to be completed within the given time. This did not do justice to the tracks and the location.

For the 2008/2009 school year both the route and the tracks of the Soundwalk will be reduced, which allows the programme to be completed in time. The application is currently on offer to havo-vwo (advanced secondary education and pre-university education) students, to whose level the game is better geared. It will also be offered to third-year and higher vmbo students.

photo: Karina Boogaerds

FACTS & FIGURES

Website: www.digitalplayground.nl
Developed by: Digital Playground and Hootchie Cootchie Media
Year: 2006-2008
Target group: Secondary ed., all levels
Technology used:
> Hardware: MP3 players, cameras and laptops
> Software: Digital Playground tutorial, Photoshop, Magix video

innovating
realistic meaningful
education
history
lower classes
location-based game

FREQUENTIE 1550

Description

Through Frequentie 1550 (Frequency 1550) pupils learn about the medieval town in a playful and involved manner. The focal point of Frequentie 1550 is the map of medieval Amsterdam in the year 1550. This map has been divided into 6 zones which each have their own theme: labour, trade, religion, administration & law, knowledge & skills and defence. The themes are linked to the function of a specific zone in the medieval town.

The game is played in teams of 4 pupils, divided into web players and street players. The street players have been provided with a gamephone (mobile phone with GPS) and a videophone. The gamephone allows them to see themselves moving on the medieval map and to receive assignments. The video-phone is used for communication with the web players and watching theme videos. These videos are linked to the 6 zones in the town.

The web players are in front of a computer at the headquarters. On their screen they see the medieval map with the assignment locations and the locations of the various teams. They can monitor the street players' movements and actions in real time. They make strategic decisions to outsmart other teams or to thwart them. The web players receive pictures and videos from the street players. They help the street players solve the assignments by finding information on the Internet. By carrying out the assign-ments the players learn about the size, organisation and function of the medieval town. They also discover the origin of medieval proverbs. Moreover they learn to analyse and interpret information from online and location-bound sources on the Middle Ages. The assignments are varied: the pupils are asked to portray someone

or something, to find knowledge by doing research on location, or to take pictures and/or make videos. The web players make strategic decisions to make their team win.

Experiences

The first Frequentie 1550 pilot was played in March 2005. The pupils were very enthusiastic; both the street players and web players were very keen in carrying out their assignments and playing together. The learning effects of the game were studied afterwards by ILO and IVLOS. Frequentie 1550 was played and studied again in 2007. Before this study Frequentie 1550 had been improved in a number of aspects. The duration of the game was reduced by 2 days to 1 day. The umbrella story was left out, because pupils found it difficult to distinguish fact from fiction. A number of game rules were adapted, because the number of points scored for parts of the game were not always in keeping with the educational aspect of the game.

In 2007 ten classes of five different schools in Amsterdam (OSB, MLA, MCO, IVKO and Amstel) played the Frequentie 1550 game.

Ten other classes of these schools took two regular lessons in which the same information was covered. Data was collected before, during and after the games and lessons. The pupils were observed, the findings were noted and reports were compiled.

The major conclusion of the study is that pupils who played the game scored better on a knowledge exam about medieval Amsterdam than the pupils who took the lessons. The pupils may have remembered more of the information because it had been presented to them in a realistic meaningful context. Their experiences on location and their active contribution to a story seem to be of great value in the transfer and recollection of information. Moreover it turns out that the street players become motivated by their physical experience and their active roles in carrying out the assignments. Web players on the other hand become motivated by the strategic decision-making with which they can direct the game and guide the street players. Street players are keenly focussed on fulfilling the assignment well and in an original manner, web players on the other hand keep an overview and feel in control.

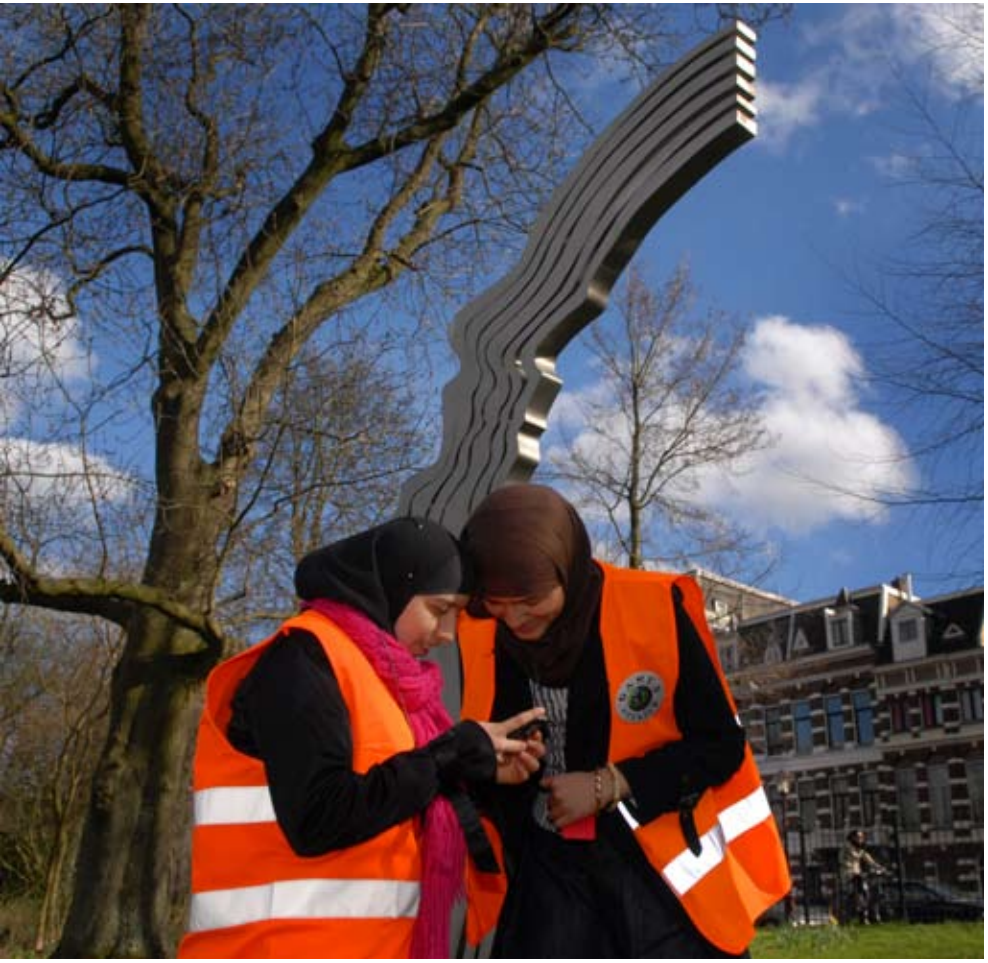
The study focussed on the learning effects of playing the game. It is expected that creating a game will yield very different, possibly stronger, results. The sequel to Frequentie 1550 is Games Atelier, in which pupils can create location-based games themselves in an online learning environment. A more detailed description of Games Atelier is available in this publication as well. At the same time the Frequentie 1550 game is being re-implemented using Games Atelier. It will be possible to play Frequentie 1550 in Games Atelier by the autumn of 2008.

FACTS & FIGURES

Website: www.frequentie1550.nl and www.gamesatelier.nl
Developed by: Waag Society in collaboration with teachers of schools involved
Year: 2005-2007
Target group: Secondary ed. lower classes, subject: history
Technology used:
> Hardware: mobile phones, PDA with GPS
> Software: own software

information gathering
multi-diciplinary
learning in an authentic context
GPS
creating and playing games
players as producers

GAMES ATELIER



Description

Games Atelier (games studio) is a new learning tool which is geared to students in secondary education. They use mobile phones, GPS and the Internet to collectively create, play and watch location-based games.

The games use the students' direct surroundings as a source of information and as the setting for a gaming storyline. Various types of information, stories and media can be made accessible to the players on location via mobile phones with GPS and information can be added by them as well.

The point of departure for Games Atelier is that knowledge is recalled better when students transform it into game formats themselves, and when it is experienced on authentic locations. Games Atelier allows students and teachers to create mobile games anywhere on relevant subjects. The students' own surroundings are especially suited, as they will learn to understand and apply knowledge in an authentic context that is relevant for them. With Games Atelier students learn in a constructive, collaborative manner. Apart from the teaching material they also learn the principles of educational games.

The games are created in an online environment. In order to create a game students come up with a concept and storyline, using so-called game boards. They develop game rules and place media and assignments on a digital map. The students can choose from three game categories: Secret Trail, Adventure or Collect &Trade. These categories each have their own game rules and their own level.

Playing the games takes place in the students' social environment. They navigate their surroundings using a mobile phone

with GPS, looking for assignments or game clues. They create media themselves and send it over the phone to the web environment. Their progress is visible online. Each game can be watched afterwards, so the students can share their experiences and reflect on their learning moments together with the teacher.

Games Atelier can be used as a small or large part of the lesson, and even as a school-wide activity. Teachers can either create games which the students will play, or they can make use of a number of ready-made games. An even larger learning effect can be achieved when students learn to create games themselves. A simple game can be incorporated into a two-hour lesson. It can then be played in the next lesson. Larger games can be designed during the lesson or in projects. This can be done by studying a certain subject in depth and/or linking it to field research.
Teachers and the school have certain responsibilities concerning the material covered in the lessons and the students' learning process. This was taken into consideration when Games Atelier was created; teachers have the final responsibility for publishing and playing a game.

Experiences

Games Atelier was developed in collaboration with teachers and students of 5 schools in Amsterdam. Students of these schools participated in a pilot on citizenship and social involvement from January to March 2008. First a discussion was initiated on the theme of citizenship. The teenagers then were asked to create a mobile game in their surroundings. In this game they showed how they experience society and what they find important. The pilot yielded 7 games which were presented to a professional jury. The winner was 'De ingeburgerde Oost'. Reaction by students and teachers during this first pilot were very positive. The students were challenged by the assignment to create something in their own area. The most difficult thing was to come up with a good story. It became clear that they quickly came to grips with designing games and became highly motivated to create something of their own. Participating in the pilot was even more exciting when it became clear that Mayor Job Cohen would participate in the winning game during the launch of Games Atelier in Amsterdam.

Teachers are very keen about Games Atelier as well. The reaction of a French teacher: "Creating a location game using a website is a new way for students to handle the learning material. Not only teachers can make a game, students can also be given the assignment to incorporate the teaching material in a game. They create a game for their fellow students, an appealing way to learn. The end product is playing the game in class using mobile phones with GPS. Recommended for project weeks!"

The students are currently involved in creating location-based games with their teachers for other subjects as well, such as history, geography, art and cultural education, and languages. Form January 2009 Games Atelier will be freely available for the entire Dutch secondary education. A competition will be organised, the 'Mobile Game Quest', which allows students to show how they create educational mobile games for different subjects and environments. In collaboration with the ILO of the University of Amsterdam and the IVLOS of Utrecht University, a follow-up study will be launched to investigate the learning effects of not only playing, but also creating location-based games.

FACTS & FIGURES

Website: www.gamesatelier.nl and www.7scenes.com
Developed by: Waag Society, Montessori Scholengemeenschap Amsterdam, Open Schoolgemeenschap Bijlmer, DMO gemeente Amsterdam
Year: 2008
Target group: Secondary ed.
Technology used:
> Hardware: mobile phones, GPS
> Software: 7scenes

mathematics
lower classes innovation
construction of geometric figures
gameplay
non-location bound game
education

MOBILE MATH

Description

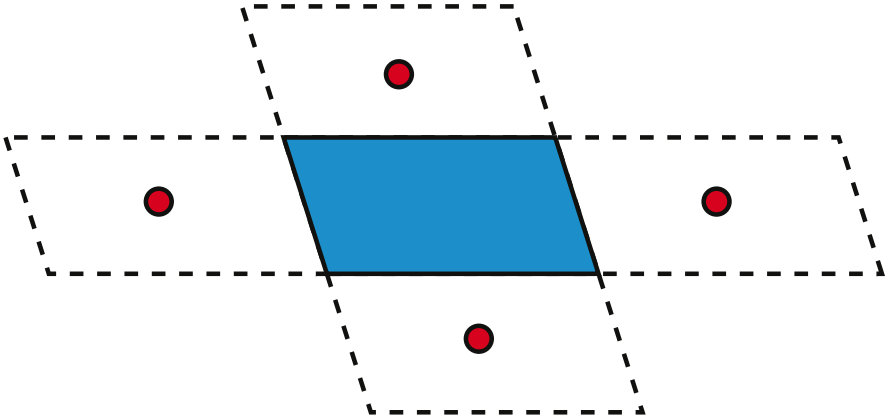
Mobile Math is a pilot for deploying mobile games for mathematics education in the lower classes in havo/vwo (advanced secondary education/pre-university education). Its goal is to make pupils learn about the construction of geometric figures and how to apply this knowledge strategically. The game is played in eight teams of pupils, all provided with a mobile phone. In the playing field around the school pupils can score points by constructing quadrangles using the mobile phone with GPS functionality. The team with the highest score is the winner.

A quadrangle is formed by fixing four corners on their physical locations using the mobile phone. During the game the constructed figures become visible as coloured elements on the screen. The sides of the figure need not be walked; they emerge because the system draws a straight line between the fixed points.

A correct shape is shown in the left image (below); and an incorrect shape is shown on the right. The more difficult the figure, the more points can be scored; parallelograms are the most difficult and squares are the easiest.

Teams can thwart one another by blocking the construction of figures or by erasing other figures. The construction of another team's figure can be blocked by quickly forming a figure of one's own in this area. The pupils need to consider whether they create a large or difficult figure, which gains them many points, or quickly walk small squares, which yield less points. Teams can also erase their adversaries' figures. To do so pupils need to 'touch' a corner of the figure. The deconstruction mode is then activated on their mobile phone. The pupils then need to determine where the centres are of the imaginary patterns adjacent to

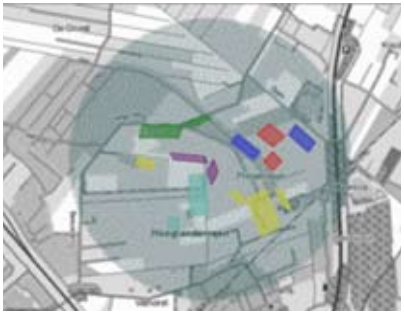
the sides of the selected figure. By walking across these centres (see figure) they make the quadrangle disappear from the map. This creates new room in the field. Pupils especially like taking areas away from other teams, and they earn additional points for doing so.



Experiences

The first version of Mobile Math was tested on three different schools in the Netherlands (Pieter Nieuwland in Amsterdam, Via Nova in Utrecht and Vathorst in Amersfoort). Each test started with an introduction of the game by the teacher. The pupils subsequently set off in pairs. The playing field had a radius of one kilometre and the duration was one hour. Afterwards an evaluation was done in class using a questionnaire.

The pupils reacted very enthusiastically. One pupil said during the evaluation: 'it is just like you're a ruler yourself.' They quickly picked up the aim and the game rules of MobileMath. The technology functioned well on all schools and locations, and the pupils indicated that they thoroughly enjoyed playing MobileMath. The rules were simple, but the gameplay was captivating and motivating; during one pilot two girls even jumped over a ditch in order to complete their figure.
More studies have been proposed into the possibilities of MobileMath for education in the near future.



FACTS & FIGURES

Website: www.mobilemath.nl
Developed by: Freudenthal Institute and Waag Society
Year: 2008
Target group: Secondary ed., pilot with lower classes HAVO and VWO
Technology used:
> Hardware: PDA with GPS
> Software: MobileMath CAB

PDA
biology
GPS
higher education
field trip
gathering data
autonomously

BIOCACHING

Description

Biocaching has been designed to provide students with a means to collect, process and analyse the data of a field trip location. A second goal of the project is charting the possibilities of this application, so that mobile equipment can be used in more field trip courses.

Teachers can chart routes that can be walked by students in pairs using a PDA. They can see where they are and where the assignments are on a survey map. During the walk the students collect location-specific data of, say, a nature reserve. After the walk they combine all the data from the entire group for processing and analysis. Students can store data and use them in subsequent fieldwork assignments through the years. The routes that are walked are placed on the Biocaching website, allowing other users to select existing routes by location and by learning goal.

Experiences

Pilots and workshops were held in various disciplines at the VU and Fontys between September 2007 and February 2008. Students indicated that they enjoyed setting off on their own and thought it was instructive. The major added value of Biocaching shows in repeated fieldwork over a longer period: location-specific information can be compared immediately over various periods of time. It is also a great tool for students who have missed a field trip. They can set off autonomously later on and catch up. Students who had some experience with the use of the equipment were the most enthusiastic. Students in geosciences who had already worked with location-bound data in their first year even indicated that they would prefer to always use Biocaching in their fieldwork.

Good (ICT) support has proved a critical factor, especially with larger groups of students. Teachers and students need to be instructed before they use the equipment, and there needs to be a loaning system in place for the PDAs. An important selection criterion for the PDAs is a long-life battery, as the stored data must not be lost when the battery is empty. Currently Biocaching is being brought to the attention of teachers in training. They could well use Biocaching to put their knowledge to use in a practice-based assignment for their graduation and create a walk for their pupils.

FACTS & FIGURES

Website: www.biocaching.nl
Developed by: VU, Spinlab
Year: 2008
Target group: Higher ed., biology students
Technology used:
> Hardware: PDA with GPS
> Software: MScape, Arcpad

GPS
collaboration
the city as learning environment
media archeology
competition
create play view
data networks

MOBILE LEARNING GAME KIT

Description

The Mobile Learning Game Kit (MLGK) was designed to the motto 'The best model is reality'. Students learn to use the city surroundings as a source of knowledge, information and investigation.
Armed with a mobile phone the students are sent into the city. The city is the playing field, where information is hidden on various locations, such as buildings whose architectural style shows the period in which they were built, their target group and their aim (and new goals they have been re-used for over the years), or the various centres that have been formed over the years under the influence of developments in the economy, technology, traffic, society and culture. The city literally is a labyrinth of numerous information and data networks that converge and diverge at nodes that are sometimes unexpected.
It is the students' task to detect and collect the hidden information, and to link it to the Mobile Learning Game Kit platform using mobile ICT.

The Mobile Learning Game Kit has three main options: Create, Play and View - the possibility of creating a game, playing it and watching it live or afterwards from the archive. The information that students collect on location is sent to the MLGK platform and is stored there. Moreover there is the possibility to link geographical locations to assignments consisting of photos, video images, sounds and texts. The mobile application also allows students to play routes made by others, receiving all media and assignments at the specific locations through a GPS connection.
By using MLGK, students learn to transform their own experiences and research into a learning experience for others. MLGK is especially applicable in subjects that have a geographical aspect, like Media-archaeology in this pilot.

The interaction between the virtual and physical realities is not the only way in which the MLGK platform is innovating. Students are stimulated to collaborate in a new manner by adding gaming elements to the MLGK concepts, such as completing a storyboard, a timed race, scoring points for assignments and a treasure hunt structure.

Experiences

First-year academic students of Media and Culture went to work actively with the MLGK for the first time in 2007. There were 2 user tests: 'Film History On the Street' - a knowledge quiz on the movie history of the Nieuwendijk in Amsterdam - and 'Youth Culture On the Street' - a reporter route with as its subject the emergence of youth culture and popular culture in the Nieuwendijk. Each game was played by teams of three students. A clear division of tasks appeared to be the most effective to achieve good results as quickly as possible: one person to create the story and add information to the storyboard, someone to manage the mobile phone and follow the leads for the treasure hunt, and finally someone to scan the surroundings for interesting (hidden) information.

In 2008 the MLGK was developed further into the 'Walk and Play' environment, a technologically more stable and user-friendly version of the first MLGK. The UvA and HvA drafted an educational memo in which the contribution of the MLGK to education is described from both a traditional and innovating perspective. Subsequently another pilot was organised with 30 students of Media-archaeology to experiment with various storylines and learning methods, such as street players and web players. A competitive element has also been added, which raises the motivation for playing the game, but has as a side-effect that students only play for points.

It turned out that the MLGK supports active knowledge gathering and processing by the students. The following learning effects applied: learning to 'read' the (urban) surroundings; the critical questioning of the (urban) surroundings; collecting, processing, analysing and presenting information multimedial; collaborating as a team. Especially creating a route proved instructive. When students are asked to create a route they are forced to immerse themselves in the learning material. Designing a game means more than involvement with the content: it also means taking into account the intended target group and communicating the content to this target group. It became clear that developing a good scenario is of major importance for the game's success.

As a concept the MLGK is generally considered to have much potential. The pupils are enthusiastic about the project and they have much faith in the role that mobile learning will be able to play in the future of education. According to the participants, the MLGK can be widely deployed, both in terms of age groups and levels.

For future use it is important to recognise the fact that media files are required which are smaller than is regular for the Internet, due to limited bandwidth. Also, the roll-out of the MLGK will require good coaching, information and training, because most teachers have had little experience with matters like designing games. Finally adaptation of the game design and content is probably required when the game is used in other disciplines than Media studies.

The original MLGK Walk and Play platform has merged with the 7scenes platform (www.7scenes.org) that is used also for the Games Atelier. This situation not only offers broader functionality and therefore more flexibility and possibilities for adapting games to specific educational requirements, it also provides the MLGK project with sufficient scale and support to further develop the end product of this project in collaboration with other parties – after all, new media are never a finished product – and to roll it out.

FACTS & FIGURES

Website: www.mlgk.nl
Developed by: University of Amsterdam, Hogeschool van Amsterdam (Medialab), Waag Society, Stichting SURF
Year: 1st pilot 2007, 2nd pilot 2008
Target group: Higher ed.
Technology used:
> Hardware: mobile phones and GPS
> Software: own (based on Keyworx and Geotracing, further developed into Walk and Play and 7scenes)

mobile education
epidemic
simulation
role playing
wi-fi
networking

OUTBREAK @ MIT

Description

'Outbreak@MIT' is a game for higher education in which players research a potential epidemic on the MIT campus in Boston (USA). The game starts with a fictional story about a plane of which one of the passengers is potentially infected with SARS. The players need to analyse the situation as a team and prevent the disease from spreading. The game is played in a combination of the virtual world and the real world. The virtual world is visible on a PDA, and the physical playing field with real players consists of a number of rooms on campus. The participants are given different roles with various skills. As they go along, they find out that they can control the situation only by working together.

The players can undertake various action with their PDAs, including:

- Taking virtual samples and testing both real and virtual players.
- Distributing medicines among real and virtual players.
- Wearing (virtual) protective clothing.
- Quarantining people.

The game software also allows them to conduct interviews. Also, the spread of the disease can be modelled on the basis of the actions and locations of the players. In this game the players learn to deploy their specific skills effectively. They also learn to collaborate, communicate and think strategically.

Experiences

Pilots have been held with Master students of epidemiology, Bachelor students of educational technology and students in secondary education, among others. The students were observed during the games and reflection sessions were held. An important strong point of the game is its excellent fit into the 'new Learning' philosophy. The players need to become engrossed in their roles and in doing so they learn to collaborate and think strategically.

The different participants interpreted the assignment in their own ways; the epidemiologists considered the game as practice for effective response to such a situation, whereas the students in educational technology saw it as a method to learn to collaborate and communicate.
All students were very enthusiastic on the way in which they were caught up in this exciting game. A secondary school student explains: "When someone got sick I wanted to help, but then I ran a risk of becoming ill myself. When an infected person mingles in a group it is especially important to make sure he doesn't become ill".

Outbreak@MIT has no clear winner or loser, the students are to assess their own level of success. This reflection turns out to be an important learning moment for the students as well.

FACTS & FIGURES

Website:
education.mit.edu/ar/oatmit.html
Developed by: MIT
Year: 2004-2006
Target group: Higher ed. and adults
Technology used:
> Hardware: PDA with GPS
> Software: Developed by MIT Scheller Education Program

REFLECTION

REFLECTION

Developments in the field of ICT are taking place fast. In the lives of young people ICT is playing an increasingly big role; they often use many ICT applications and in doing so assume an active, usually producing role. Learning methods with modern media that can result in higher involvement of pupils in the learning process offer new possibilities in education.

Education is increasingly geared to the changes and developments mentioned above. Teachers are looking for new ways in which to deploy their professional expertise and experience of life, not only as an expert but also as a guide and coach. The technologies that can be deployed are becoming more accessible and easier to use, and this also applies to mobile and location-based learning.
The various examples of actual practice in this publication show some of the possibilities. It has already been mentioned in the introduction that the first step is to consider how, and with which goals, one is going to deploy mobile technologies in education. This reflection will yield aspects that should be considered carefully in order to achieve successful implementation into the curriculum.

Goals

The choice for a learning method depends on the goal which the teacher wishes to achieve. There should be a reason why especially mobile technology is deployed as a (supporting) learning method.
One reason to do so is that technology stimulates many young people and that learning through games is motivating. A good game enables pupils to learn autonomously. Reasons to choose a mobile technology can be: a computer room is not required, information and/or assignments can be linked to locations and so make a bigger impression. The real world can play a role in the game and be part of the learning process. Using GPS and/or mobile internet, direct interaction with other people and with the surroundings can be integrated into education.

Being able to monitor others, whether online or mobile, is motivating for many pupils; it adds a sense of competition - they want to perform the activity better or faster. Monitoring others can be a reason for teachers as well to work with GPS. In front of their computers they can find the pupils on a digital map and see how they are performing on their assignments. They do not need to join the pupils. Naturally it will depend on the degree of autonomy and the maturity of the pupils whether a teacher chooses this approach. He or she can also select a project in which adults accompany the pupils on their route.

Also the use of mobile technology provides room for collaborative learning; this requires no separate system. It is possible to have consultations using chat, text messages (sms) or the phone. Face to face consultations are still possible, as well as the use of other online means of communication that is much used by young people in social networking.

It is important to make the learning methods and the goals meet and to include sufficient moments of reflection for the pupils.

Target group

It depends on the target group which kind of learning method and activities are most suited. In primary education mobile learning is especially useful when it is offered as a game or exciting field trip, preferably with a strong narrative aspect.

In secondary education the technology should be appealing in that it is geared to the social world of teenagers, as well as actively dealing with knowledge and creating knowledge. But with these pupils as well narrative learning through gaming offers an added value in terms of motivation and learning effect. Especially competitiveness is a major factor in pupils of secondary education.

In higher education learning methods are developed in which the student is involved in determining the content and linking the content to his or her direct social environment. The city is used as a learning environment, or data in the field are made accessible by mobile technologies. More than with younger target groups this target group often finds it essential that their autonomous learning can take place everywhere all the time. If required it can take place with remote guidance.

It is important to ensure that the learning method and the type of assignments match the level of the target group, and to keep an eye to the duration of the project. The distinction between the real part and the virtual/fantasy part needs to be clear, especially for younger pupils and pupils in preparatory vocational education.

A final consideration is that the media used should be geared to the level and specific skills of the target group. Pupils that have trouble reading may find a game based on much text too difficult. In such cases it may be better to select a form in which audio and video play an important role.

Learning methods

The examples show that a gaming structure is selected as a learning method in many mobile GPS projects. Playful learning is motivating for many pupils. Moreover a game offers pupils the possibility of assuming various different roles that can help them learn.

Even within a game there are still several learning methods possible. Pupils can play the game on their own, but most games are played as teams with and against one another. Pupils that play in groups have shared experiences; they can help one another and they can experience different roles. They also learn to work together well and to complement one another. The element of competition can be introduced, which most pupils find highly motivating. They are used to playing games in which they are playing against others and they want to win. And a practical reason for having pupils collaborate is that they require only one device.

Another learning method is a route that is walked by the pupil (Soundwalk), or that is created by the pupil (Biocaching, MLGK, Games Atelier, De Zingende Stad). This learning method emphasizes the interaction of the pupils with the location; the pupils receive information on location that they need to act upon, or they record data or media with a camera or a mobile phone.

The role of the teacher varies with each learning method. The teacher is often a coach who ensures that the pupils are well-prepared for the project. He or she also makes sure that the pupils evaluate their experiences in a good manner, and reflect upon it. The teacher can choose to participate in the project or game, but pupils may feel freer when a teacher does not join in. Some games allow the teacher to monitor online (Games Atelier, Frequentie 1550, Veenquest).

In any case the teacher needs to have good knowledge of what the pupils have done and discuss their experiences: what has the route or the game evoked? What kind of assignments have been carried out, and which choices have the pupils made? Teachers need to

address these issues immediately after the game has been played. This is an important learning moment and it is important to subsequently transfer the results into the classroom situation. The disadvantage of waiting until the next day is that part of the game flow will be lost.

In general a combination of various learning methods works best. A game can be combined with many other learning methods. TimeLab for instance combines the mobile learning method with debate/reflection. When combining learning methods it is important not to disrupt the game flow. If pupils need to write things down too often during the game it becomes hard for them to be engrossed in the game. A clear division of tasks within the team can solve this.

Added value

Under Goals we saw that the use of mobile technology can have added value for situation-based, narrative learning everywhere all the time, and that this is motivating. Another example of added value is the fact that pupils remember more about the subject when playing a game. Research into Frequentie 1550 has shown that pupils who had played the game remembered more about medieval Amsterdam than pupils who had been provided with the same knowledge in a regular lesson.

Games and simulations allow people to experience things that are impossible in the real world. In Frequentie 1550, for instance, medieval Amsterdam was experienced, in Veenquest and TimeLab on the other hand it was future scenarios. In Savannah children could go to other countries and be animals. Outbreak@MIT presented the possibility of experiencing the effects of an epidemic very realistically, without a real epidemic raging.

Pupils often find playing a game exciting. They are easily involved in the story by playing a character of their own or by receiving information from interesting game characters. They become part of it, instead of listening passively, which makes them remember better. Especially when pupils can co-create (part of) a story (Games Atelier, Frequentie 1550, MLGK, TimeLab), they learn much about the content, and the knowledge is retained better. But as we mentioned earlier, they sometimes find it difficult to distinguish between fact and fiction, especially younger children. Particularly in a lesson in which factual knowledge is an important aspect, such as a history lesson, it can be important to clearly distinguish the fictitious game story and the factual knowledge.

Another added value is in the collaboration, the mobile exchange of information that usually is immediately available through various sources. This form of information on demand and learning from one's friends (learning in informal networks) matches the skills and expectations of the digital generation. Besides collaboration there can also be competition, in which the results of various players are directly visible, so they can be compared. This is also a great motivator for the pupils. Finally, location-specific can be gathered at various moments. These data can then be analysed over a longer period of time, as in Biocaching.

The teacher and the user-friendliness of the technology

For pupils the use of mobile technologies is often easier than for teachers; pupils can be more familiar with them and they learn easily. The pupils can often help the teacher to work with the mobile equipment. As a teacher do not be afraid to learn from your pupils! They think it is great and it gives them more confidence... and by explaining they also learn.

The effort required from the teacher varies with each project. A teacher can look up for each application what the project requires in terms of preparation and guidance. This allows the teacher to select a suitable project. Some projects consist of workshops that are organised and facilitated by other parties. This is the case with the project examples Veenquest, Soundwalk, Frequentie 1550 and Mobile Math. Other projects consist of the use of a tool or computer programme that allows the teacher or the pupil to create

the content for a project. Examples are Games Atelier, Lopend Leren, De Zingende Stad, Biocaching, MLGK and Create-a-Scape. Preparation for projects in which the pupil or teacher create something by themselves often takes more time and may require technical skills from the teacher. A big advantage is the possibility of adapting the application completely to the specific learning goals and the educational practice.

Considerations for a teacher to select a certain type of project can be the time he or she has available and the extent in which he or she is proficient in mobile technologies.
In any case it is vital that the teacher should be eager to deploy the new technology in education. The teacher has to provide good coaching, gear the project to the learning preferences, ensure clear learning goals and sufficient challenge and feedback.

With our discussion of the theory and examples of actual practice we hope to have sufficiently inspired you and to have provided insight into the developments and possibilities in the field of mobile and location-based learning. Further application and dissemination in education will lead more insights, broader applicability and accessibility.

To conclude, the table below provides a survey of all projects under discussion here with additional information that may help you to judge whether you wish to deploy a certain project in your classroom.

project	type of education*	subject	content developed by	equipment / technology
Zingende stad	PE	Music, various	Yo! Opera, Waag Society, OBS De Rietendakschool	Mobile phone with GPS
Lopend leren	PE	Multi-disciplinary	Univ. Leiden and others	PDA
Create-a-Scape	PE	Multi-disciplinary	Futurelab	PDA withGPS
Veenquest	PE/ SE	Biology	Hogeschool Leeuwarden, lectoraat ICT en veranderende didactiek (lector J.Lepeltak) and IVN Leeuwarden	PDA with GPS
TimeLab	PE/SE	Natural sciences	MIT	PDA with GPS
Soundwalk	PE	Art & Cultural education	Digital Playground and Hootchie Cootchie Media	MP3 player, camera
Frequentie 1550	SE	History	Waag Society, MSA, OSB	Mobile phone and (seperate) GPS
Games Atelier	SE	Multi-disciplinary various	Waag Society, MSA, OSB	Mobile phone with GPS
Mobile Math	SE	Mathematics	Freudenthal Instituut and Waag Society	Mobile phone with GPS
Biocaching	HE	Biology	VU Spinlab	PDA with GPS
MLGK	HE	Multi-disciplinary various	UvA, HvA, Stichting SURF and Waag Society	Mobile phone with GPS
Outbreak	HE	Various	MIT	PDA with GPS

* Abbreviations: PE: primary ed., SE: secondary ed., HE: higher education

preparation	development status*	cost of use	rental equipment
> 1 day training for use	Pilot: 1 January 2009		
> 1 day training for use, content lesson: variable	Pilot, being developed further	None	PDA to be purchased or rented
> 1/2 day training use of software, > 1 day creating content and planning	In use	None, use in UK only	PDA to be purchased or rented
None	In use		Backpack with learning materials: 7,50 euros per PDA
Discussion in the classroom on the preceding and the following day	In use	None	None
Optional at: www.shop4media.nl	In use	350,- ex. VAT for 40 persons	Present during workshop
Discussion in the classroom on the preceding and the following day	Pilot, being developed further	To be decided	Present during workshop
> 1 day training use of software, > 1 day creating content and planning	Pilot, available nationwide in NL on 1 January 2009	During pilot: for free From 1 January 2009: approx. 550 euros annually for licence	To be purchased, rental possible if required
Discussion in the classroom on the preceding and the following day	Pilot		
> 1/2 day creating content > 1/2 day construction and testing	In use	None	Not yet possible
> 1 day training use of software, > 1 day creating content and planning	Pilot	To be decided	To be purchased
1 hour in the classroom	Pilot	None	Present during workshop

* Some projects are still in their pilot stage, but they will be made available in education in the near future.

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Consulted website:: http://www.natuurlijkleren.net
See also the www.mobieleonderwijsdiensten.nl website for further information and projects in the field of mobile learning.

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