How are digital games used in schools?

Complete results of the study

Final report

This final report provides the complete results of the study *How are digital games used in schools?*, published in May 2009. A synthesis report has also been published under the same title.

A practical guide entitled *Digital games in schools: A handbook for teachers* has also been published in the framework of this project.

Publisher European Schoolnet
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Belgium

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Printing Hofi Studio (CZ)

Print Run 300

Picture credits Derek Robertson, Ella Myhring, Alawar Games (Farm Frenzy), IPRASE, Waag Society, Microsoft (Zoo Tycoon).

This publication was printed with the financial support of ISFE.

ISBN 978-9078209874

Tell me and I forget,
Show me and I remember,
Involve me and I understand

Ancient Chinese proverb
Confucius (551-479 BC)

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Foreword

Digital games are important for education systems in two ways. First, they are important because games are a very popular and widespread leisure-time activity for the age groups whom these systems seek to educate. Through gaming during their leisure time, youngsters informally and inevitably acquire certain skills, knowledge and values. With digital games increasing in popularity to such a great extent, it would not be wise for education systems and teachers to ignore them.

Secondly, digital games are possible vehicles for learning processes of a different nature. Providing schools with information and communication technologies (ICT) in the form of computers, software, internet access and digital content, and providing teacher training programmes for these technologies, have not proved sufficient for the teaching process to be transformed. Personalisation of teaching and learning, trans-disciplinary approaches, meta-cognitive development and learner empowerment, have not been systematically implemented by bringing ICT into the classroom. Digital games have the potential to contribute to this renewal, through the resources and know-how invested in their design to challenge players and keep them interested.

When the Interactive Software Federation of Europe (ISFE), commissioned European Schoolnet to produce an overview of the use of digital games in schools in Europe, it was seen as an opportunity for the education systems it represents to identify and better understand what is happening on the ground. European Schoolnet was, however, not new to the topic, having already acted as a partner in a project called eMapps.com, funded under the European Commission's 6th Framework Programme for Research and Technological Development. This project (2006-2008) was about learning through games and mobile technology in both school and informal settings. European Schoolnet is also a partner in another two-year project called Imagine, initiated in late 2008 and funded by the European Commission's Lifelong Learning Programme. Its objective is to valorise the outcomes of projects and initiatives to support the implementation of game-based learning strategies at policy level.

These two projects and the present Games in Schools study are all first attempts at European level to better understand in what ways and to what extent digital games could contribute to improving teaching and learning processes in schools. They show that teachers presently using digital games in their teaching seem to value them for different purposes. The precise role to be assigned to the teacher when using games in the classroom, the way digital games can support different learning styles and the respective contributions of different types of games to various learning processes, are just a few examples for more in-depth investigations to be launched in the near future. This could be the next step for European Schoolnet to pursue its input into the field, in close cooperation with the best known scientific researchers.

Marc Durando
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European Schoolnet.

EXECUTIVE SUMMARY

Between April 2008 and March 2009, more than 500 teachers were surveyed and more than thirty political decision makers and experts were interviewed. Six case studies and a review of the scientific literature were carried out. An online community of practice was launched to provide material for a handbook for teachers.

The aim of this investigation was to address two main questions: What can digital games bring to classroom teaching? What kind of cooperation can be envisaged in this precise context between education systems and the games industry?

The survey of teachers reveals that – regardless of their gender, age, number of years in the profession, familiarity with games, age of their pupils, or the subject they teach – teachers do indeed use digital games in the classroom. Some of them encounter difficulties in integrating games into the curriculum, partly due to a lack of equipment and the reservations of parents and their colleagues about the use of digital games. They use educational games, but also, and more often than might be expected, they use commercial and leisure games. Whatever the type of games used, teachers hope to increase their pupils' motivation and improve their skills. In practice they observe these effects in renewed motivation and progress in certain skills (social, intellectual, spatio-temporal, etc.).

The case studies demonstrate the existence of practices in this area which remain small in number but which sometimes large in scale in terms of the number of teachers and pupils concerned. The teachers who are involved in these practices leave nothing to improvisation in their pedagogical use of these games; on the contrary, they prepare them very carefully. Experiments in using games in the classroom are bringing teachers together in a community of practice, as well as uniting the whole educational community and parents around pupils' achievements. Practices centred on games rehabilitate more traditional teaching tools in the eyes of the pupils.

Comparison of the approaches to digital games in different education systems brings to light four major conceptions for their use: support for pupils in difficulty, modernisation of the system, the development of advanced skills, and the preparation of future citizens who will live in a society increasingly involved in virtual worlds. The scale of support provided by the central, regional or local education authorities for the use of digital games in schools varies significantly from one country to another. More extensive and concrete support is given in the Netherlands, the United Kingdom and Denmark.

Research into using games for learning carried out over the past 20 years, but with very mixed results, shows that skills, knowledge and attitudes can be improved by means of Game-Based Learning (GBL), given the right environment. However, the choice of game along with the environment in which it is situated and the teacher's role as moderator are vital if the desired learning outcomes are to be achieved. Video games can supplement traditional learning but not replace it. But the majority of today's teachers willing to incorporate GBL into their lesson plans lack the knowledge and level of skill required to implement this technology successfully.

The practices analysed confirm the positive impact of the classroom use of digital games. They nevertheless remain small in number, and more in-depth analysis, including cases where the use of digital games did not match the teacher's expectations, would be required for a more precise evaluation. In order for this potential to be fully realised, several recommendations are put forward: to develop the evaluation of practices, to (re)consider games in the light of recent research on cognitive processes, to make games eligible in the mechanisms for supporting the modernisation of education systems, to develop cooperation between the games industry and education around ambitious projects, and to envisage the European territory as an experimental laboratory.

INTRODUCTION

Teachers use digital games in their classroom teaching. Why do they choose to do so? What types of games do they use? What do they do with them? How do they integrate them into the curriculum? What pedagogical objectives are they aiming for and what results do they obtain from their pupils? In other words, what is the interest of this approach for an education system? And what collaboration could be envisaged in this context between education and the games industry?

To answer these questions, the Interactive Software Federation of Europe (ISFE) entrusted European Schoolnet with the task of carrying out a first review of the situation at the European level. As the network of ministries responsible for education, and more especially for its modernisation through information and communication technologies, European Schoolnet was well placed to explore this subject.

The study extended over several months, from spring 2008 to spring 2009, without any preconceptions for or against the use of digital games as teaching tools potentially usable in the classroom. The investigation was divided into several parts: a literature review of the academic research in this area, a survey of teachers, case studies, interviews with educational decision makers, and an online community of practice.

Because this was the first study in this area covering several European countries, priority was given to collecting as much information as possible about the experiments currently going on. For this reason, the term 'digital/electronic games[1]' had to be taken in a broad sense, covering video games and online games, games that run on consoles, computers or mobile phones, whether they be adventure games, role plays, strategy games, simulations, racing games or puzzles. Eight countries were particularly targeted: Austria, Denmark, France, Italy, Lithuania, the Netherlands, Spain (Catalonia) and the United Kingdom. In each country, a national coordinator helped to identify and collect the relevant information at national level, following a content guide that was common for all countries. The opinions and practices of teachers in both primary and secondary schools were investigated.

The questions that were asked aim first at identifying the practices. They also belong to a wider framework of reflection which includes the challenges that education now faces: pupils who display a growing disaffection from an education system that they perceive as remote from their everyday realities; the development of the cognitive sciences, which understand better the modes of learning that learners implement, and questions the efficacy of the pedagogical approaches generally used up to now. Education systems themselves are evolving, increasingly placing the emphasis on defining competences to be attained rather than content to be learned. Specific pedagogical tools are needed to support the development of these competences, which are now defined as 'key skills'. To what extent does the use of digital games in the classroom make a new or useful contribution to meeting these challenges? That is the fundamental question underlying the study presented in this report.

[1] The terms 'digital games' and 'electronic games' are used synonymously throughout this report.

What do we observe on the ground?

4. What do we observe on the ground?

Main findings

A growing practice

Medium and large scale experiments are being conducted

Several experiments analysed in this study are on a scale that goes far beyond that of a single teacher and his or her class. The DANT project in Italy brings together teachers, experts and technicians to develop, test and use educational games in teaching maths and the mother tongue. It involved a thousand teachers and more than 10,000 pupils aged 7 to 10. It was first deployed in the Trentino region and then expanded to cover almost the whole of Italy. The Scottish project, *The Consolarium*, tested the impact of several commercial electronic games, such as *Dr. Kawashima Brain Train* or *Nintendogs*, on various pupil skills. It involved more than 500 teachers and over 30 local authorities. In the Netherlands, the *Games Atelier* project, following a pilot phase to develop a tool for 'mobile game-based learning', will be made available in 2009 to all secondary schools in the country. When it was launched, through a competition, in a few months more than 50 groups of pupils from a dozen schools took part.

Education authorities are becoming involved

Some experiments also benefit from the support of local, regional or central education authorities. They provide financial or other backing for the whole project (*DANT* in Italy, *Games Atelier* in the Netherlands, *The Consolarium* in Scotland); they purchase and distribute to schools the necessary licences and games (*Zoo Tycoon* in Austria, Højby School in Denmark). More specifically, in Scotland, a university research centre specialising in games-based learning which was recently transferred to the University of Abertay in Dundee has received a £3 million investment from the Scottish government. It has been operational since February 2009.

The involvement of education authorities generally remains limited and even very limited. Their support is more clearly seen in some countries – Denmark, the UK and the Netherlands – than others.

A structured pedagogical framework

The games and the conditions in which they are used are carefully selected

The six case studies presented below show that games, including commercial ones, are chosen by the teacher on the basis of their didactic qualities. They need to set the learning in a story and make it possible to develop new skills that build on what the pupil has previously learned. Teachers strongly prefer games which allow differentiation of learning (each pupil learns in his/her own way and at his/her own pace) and enable the learner to see what progress has been made. These are moreover the precepts of classical pedagogy. When games are used with groups of pupils who are disaffected and detached from school, they are valued as teaching tools on account of their non-traumatising qualities ('soft' management of failure, rewards given for all achievements, etc.).

The way in which the game is used is also meticulously defined. It emerges clearly from the teachers' survey that games are used in the classroom in flexible ways, depending on the pedagogical objective that is aimed

at. In the examples presented, the use may be collective (by the whole class, or in teams of two and often more), and sometimes in tandem with a team of similar size in another class or school. Games can also be used individually, especially to give support to pupils in difficulty. In all cases, after the game session, discussions are organised with other pupils (about the strategies used, for example) and with the teacher (about the difficulties encountered and the ways to overcome them).

Medium or long term experiments are being carried out

Several cases presented in this report make reference to experiments designed over a relatively long period. This long-term perspective is accompanied by meticulous preparation of the project of using electronic games in the classroom, particularly in terms of pedagogy. This approach also allows for evaluation of the project and measurement of its impact. It makes it possible to conduct the experiment in partnership with, ideally, a large number of teachers and to involve the whole educational community, including parents. In some cases, university researchers have joined in the experiment.

The DANT project extended over a period of four years. The pilot project *Games Atelier* is based on experiments initiated in 2005 (*Frequency 1550*) and itself extends over a three-year period, in cooperation with the Universities of Amsterdam and Utrecht. The *DANT* and *Consolarium* projects were additionally conceived essentially as tests to evaluate the impact of the use of electronic games on pupils' skills in the target subjects. They therefore implement research methodologies adapted to this aim (user groups and control groups, measurement of skills before and after use of games, statistical analyses of the results, etc.).

Although conducted over shorter periods, the experiments in the school in Højby, Denmark, and the school in Privas, France, are also based on a pedagogical plan carefully constructed before and during its implementation. Different phases are defined within a process whose objectives are clearly defined from the outset; the participants (pupils and/or teachers) evaluate the experiment at the end, etc.

A positive impact on motivation and various skills

Increased motivation of pupils

All the examples reported and the great majority of the teachers surveyed confirm that pupils' motivation is significantly greater when computer games are integrated into the educational process. The pupils seem to appreciate the fact that this approach takes account of their everyday reality. They like the fact that it gives a concrete purpose to the work they are asked to do (to learn about a period of history so as to create a game scenario out of it, for example) and that it enables them to be active in their learning (as players). They also appreciate the 'play' element, but some of them are sceptical at first about bringing games into the classroom. Precisely because it is a matter of 'playing games', their image of school is challenged, inasmuch as it is associated in their minds with entirely 'serious' activities.

This increased motivation sometimes seems to be linked to the greater self-confidence that some pupils develop especially when using games in the classroom. Their previous knowledge of games (not necessarily of the game in question) gives them the opportunity to guide and help other, less experienced pupils. With or without previous experience of games, the best pupils also have the chance to help the others, and they derive satisfaction from this. In addition, the

ways in which mistakes and different learning paces are managed in a game take the drama out of learning. Such features are in any case mentioned by the teachers as giving new levels of confidence, especially to pupils defined as 'less good' by traditional educational criteria.

Several types of skills are improved

Increased retention of information and knowledge by pupils is a recurrent theme among many of the teachers. The repetitions and identification that electronic games allow emerge as the two key factors explaining this outcome.

Because the games that teachers choose for classroom use are selected precisely for their pedagogical value, they generally give feedback to the pupil on the choices made and the strategies applied. This element is seen by teachers as particularly educative for pupils because it develops their understanding of their own way of learning. The fact that this feedback is an integral part of the game and not something separate (as in traditional teaching) is also seen as very positive by teachers.

The teachers' survey highlights a significant improvement in several key skills – social, intellectual, spatio-temporal (reflexes) – etc., and also in concentration. There is however one type of competence for which the results of the use of games are less clear in the teachers' eyes, namely the knowledge and skills directly linked to the subject being taught. This question would merit detailed research. It should simply be emphasized here that several of the projects presented in this study clearly demonstrate a gain in terms of the specific school subject. This is the case with mathematics (*DANT* and *The Consolarium*), the mother tongue (*DANT*) and history (*Games Atelier*). It should also be noted that these three projects employed a rigorous action-research methodology.

Interaction with traditional pedagogy

Electronic games are combined with traditional teaching aids

The case studies show that electronic games in the classroom are regularly associated with more traditional teaching aids before the actual game-playing phase. Leisure games which are inspired by a famous character or which lead the player into a period of ancient history are very often introduced by the teacher after the pupils have read books related to the game theme. In this case, teachers often report that their pupils show increased or unusually high motivation towards this reading, whether it be of novels or other more technical or factual documents. Reference to these texts also enables the teacher to lead the pupil to compare the different modes of representation used in the respective novel and game. In other cases, this reading serves to create characters, settings, actions, etc. for the scenario of the game itself (a game about the history of the colonies, for example). This interconnection between the game and traditional teaching tools generally produces better retention of the information learned by the pupil.

Electronic games encourage pupils' production

During and/or after the use of a game, the pupils show real enthusiasm for writing texts, diaries, or editorial content for a website, for making drawings and/or photographs, etc. They do so with little prompting and

sometimes even spontaneously. They are motivated to keep a record of what they have done and learned through the game and to communicate with other pupils or the wider community about their whole project. Here too, the pupils' motivation to undertake such work, which is sometimes quite substantial, is seen by the teachers as being much stronger than in the traditional scholastic environment. These more traditional productions appear to them as a natural extension of the game introduced into the classroom.

Collaborative experiences

Teachers are organising themselves into communities of practice

As a non-traditional teaching tool, games used in the classroom give rise to many interchanges between teachers about their practices. Teachers who are interested but who do not yet use games seek advice from those who have already tried them out. Those who already use them compare their experiences of the games they use, in relation to the context, the pedagogical accompaniment that they set up, and the results they obtain; they sometimes do so within online communities. The *DANT* project in Italy, for example, illustrates the setting-up of a teachers' community of practice on a relatively large scale. First, a group of teachers who design educational games is set up, and brings in other people with more technical expertise; then a larger community of teachers tests these games in their own classrooms to identify their strengths and weaknesses and recommend or suggest improvements; and finally the improved games are made available online for a large group of teachers to use them in their everyday teaching.

Such experiments, on whatever scale, also foster cooperation between teachers and their other colleagues within the school – librarians, ICT coordinators, etc.

The educational community and parents share the results

Several examples of the classroom use of electronic games are often accompanied by preliminary information given to parents, sometimes to the rest of the school community, and especially to the school management. This is particularly true in the case of the Højby school and the *Zoo Tycoon* project in Austria. Further information is provided throughout the duration of the experiment. The cautious, even negative attitudes of the general public towards electronic games, which are often identified with violent games, partially explain the need for these information campaigns.

Once the information system is set up, parents and the rest of the school community are regularly briefed about how the games are being used, the objectives, the outcomes and their evaluation. When the experimental use of the game has reached 'cruising speed', the productions of the pupils taking part are made available to the educational community as a whole and to the parents. The pupils, their parents and the school community in general seem to particularly appreciate this moment of sharing.

Højby School, Denmark

Leisure games at the service of the curriculum and teaching process

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Computer games in schools: from initial reservations to positive experiences

Classroom teaching using computer games has been a feature of teaching at Højby School since 2002, in conjunction with the school's participation in the state supported ITMF[1] (IT and Media Studies - Primary and Lower Secondary Level) development programme. Part of this teaching is shared with Høng School at 6th class level, where pupils are 12-13 years old. At first, the classroom work was to some extent experimental in nature, as the desire was to try things out and see how well suited the games were for educational purposes and, if so, in what way. Thus the experimental phase was centred within a Danish language (mother tongue) context. At that time, computer games were an unknown quantity for most teachers and there was a widespread view that this was an area that the school should avoid. Computer games were regarded as no more than a childish distraction that had nothing to do with "real life" (as defined by teachers) – games in which you just pressed some buttons and were not otherwise engaged in any active way; something that children might be allowed to do in their free time without any input from adults. In short, computer games were looked down upon by teachers. However, as it gradually became clear that there were positive elements to these games, the teaching staff were informed of the results from the test phase, and proposals for a course module were presented to all the teachers at joint meetings.

The result has been that classroom teaching using computer games is practised by many teachers at all age levels in the school, and across a wide range of subjects, such as Danish, history, foreign languages, social studies and the visual arts. This development must also be seen in the light of the fact that the average age of teachers at Højby school has gone down, and although the younger teachers do not necessarily possess greater IT or media skills than older teachers, they have been not subjected to the kind of multimedia scare stories that older teachers may have been exposed to and which were once a feature of new media analysis within education. Similar attitudes prevailed when picture books, comic books, and films became more widespread and thus became subjects of discussion within an educational context. Another factor now deemed to be important is the growing recognition of certain problem areas in teaching young children, where the lives of these children outside of school can sometimes be unknown to the teacher. Both the authority of the teacher, the teaching itself and also the pupil's own motivation can be undermined in a situation where there is no mutual referential framework. In the absence of awareness on the part of the teacher of the pupils' leisure time pursuits, in which computer games often occupy a significant place, it can

be difficult during class time to make relevant references and draw parallels that will be recognised and understood by the pupil. We should emphasise that when seeking to use computer games as part of the teaching curriculum, we focus not only on the motivation potential but also, and perhaps even more, on the educational benefits that can be obtained; we expand on this theme below.

Højby School and its environment

Højby School is a state school with 400 pupils aged 6 to 16. The class groups are organised according to age, not according to the ability or special needs of individual pupils. The school is situated in Højby (4500 inhabitants), a suburb of Odense (160,000). Højby School was formerly a village school in a fairly isolated area, but as the village grew into a town, new types of housing sprang up, so that today the school caters not only for pupils from the original housing stock but also for pupils living in new local authority housing estates, and also some 5% of pupils whose mother tongue is not Danish, which is below the average for a Danish state school.

The original initiative for the implementation of classroom teaching using computer games came from the school's learning centre, the school library. The coordinator has been qualified as a school librarian since 1994 and as a teacher since 1974 and thus has long experience in teaching all the subjects taught at the school.

Currently, class work using computer games features as a leader-controlled, obligatory part of the teaching curriculum for the 6th class in all Højby schools. Class work for other years is initiated at the instigation of the school librarian, or by the teachers who bring the school librarian on board as a partner. Classroom instruction using electronic games proceeds solely via the use of PC games. At first, teaching was carried out in designated IT areas with desktop computers on a basis of one unit to every two pupils. Now, all work is done on laptop/portable computers and with a computer for each student. The teaching is based on commercial leisure games, as well as free games, which can either be downloaded or played online. Examples of specific games which have been used over the years as course elements include *The Sims 2* (Electronic Arts), *Zoo Tycoon 2* (Microsoft), *Patrician III* (Atari), *Harry Potter and the Order of the Phoenix* (Electronic Arts), *Harry Potter and the Prisoner of Azkaban* (Electronic Arts), *Astrid Lindgrens Eventyrlige Verden* (Gammafon), *Dragon Fist* ,[2] *Adventure Quest*,[3] *Samorost 1*[4] and *Samorost 2*[5] (Amanita Design).

This report gives some concrete examples of the way these games and others have been used in an educational context. In order to make our methods clearer, it is first necessary to describe some of the salient factors involved. It is important to stress that the essential point of teaching in this way is to facilitate a greater understanding of the subject being taught and not of the individual computer games. The planning of the teaching approach, which is designed to lead pupils towards a designated goal, involves, amongst other things, agreement on the necessary teaching methods and learning resources. Within this process, there are discussions as to whether or not computer games in general, or a specific computer game, can be of use in teaching the subject. The starting point may also sometimes be a specific game, and here the educational considerations are focused on the type of aims for the given subject that the game may be able to facilitate.

Danish computer game researchers are often quoted as saying that commercial computer games are not produced for educational purposes and are therefore not suitable for use in the context of a school curriculum.[6] We agree that, in most cases, the actual content of these games does not in itself contribute an instructive element to the teaching of a particular subject. The same applies to other learning resources such as novels, which have not been written with teaching in mind. It is only at that moment when the novel, or other learning resource, is placed in an educational and pedagogical context that it becomes significant as a tool for learning. Computer games function in exactly the same way. In order to fully appreciate our positive experiences in the use of computer games, it is important to understand our teaching approach. We provide teaching *about* computer games, teach *with* computer games and teach the *background* to computer games.

Teaching *about* computer games involves, for example, raising awareness as to the various game types, gender specific games, an analysis of the games played, and then comparisons with other genres such as novels and films, and also student production of games.

Teaching *with* computer games involves a focus on the games as a starting point for subject based learning processes within the school's range of subjects, concentrating on the specific goals for each subject. In this regard, it may also be the case that a particular game supports the goals of an IT related subject, even where IT is not included as a specific subject in the school, but as an obligatory working area in all subjects, and with its own goals, expressed in the form of the JPCK concept[7] (Junior PC – Driver's Licence).

Teaching on the *background* to computer gaming involves raising awareness, for example, of games production, target groups, marketing, socioeconomic factors, the PEGI (Pan European Games Information) rating system, the risks involved in excessive gaming, the differing opinions expressed in the media regarding computer gaming as a phenomenon, gaming and manipulation, advertising, gaming as an art form and gaming as a cultural phenomenon.

How some games have been used

The Sims 2

The commercial simulation and strategy game *The Sims 2* (Electronic Arts 2004) has been used as part of teaching Danish in 6th class (12-13 years). 25 copies of The Sims 2 were given to us by Multimedieforeningen[8] and the Danish branch of Electronic Arts*, one of the world's largest developers, publishers, marketers and distributors of video games. Here, course work involved analysis of the characterisation of various personalities, descriptions of environment and ambience and novel writing, using the requirements set out in *Fælles Mål* (National Curriculum Requirements) for Danish as a starting point. This also includes an IT element. Class work in this area covered 25 lessons. The pupils were able to borrow the game for use at home prior to starting this course element, and given the fact that many pupils already knew the game, there was a large element of gaming experience on which to build. Pupils were allowed free play sessions covering two lessons. The names of the very experienced players were written up on the board so that beginners could ask them for help. As far as these "super users" were concerned, they received a lot of satisfaction from being able to act as a kind of assistant teacher. The purpose behind the study of *The Sims 2* was explained to pupils, as well as the schedule of work involved, covering 25 lessons. The pupils were then asked to enter the game again and find suitable images, which they then had to copy

resize using the *Faststone Capture*[9] programme before saving this material for use in their production projects. *The Sims 2* is precisely the kind of game that is well suited to studies based on characterisation analysis, as it is the individual players themselves who create and add personal traits to their characters on the basis of specific terms provided by the game. The personal traits of each character are visualised in the game in such a way that they facilitate an understanding on the part of the pupils with regard to concepts such as internal characterisation.

Subsequent lessons switched between involving pupils in independent study and the teacher providing the context and background to concepts requiring emphasis in the course. At certain points, the teacher would call a halt to the work in which the pupils were engaged in order to show examples of their work on the big screen. These were things she spotted as the class proceeded and which threw a particular light on the relevant concepts which the pupils were meant to learn.

The pupils worked using a word processing programme. They were asked to describe their favourite character using text and images, and part of this task included giving an account of both outer and inner characterisation. In the same way, pupils described different environments using selected illustrations from their games. The final task which the pupils were set was to write a mini novel about their favourite character using their game as a starting point. The pupils were asked to use elements from their environmental and personal descriptions. Finally, pupils read the novels aloud to each other in groups.

The course was evaluated by means of a questionnaire filled in by the pupils. This indicated that around half of the pupils believed that the use of computer games had motivated them and helped them in terms of the learning process for the relevant subject. The rest believed that they could have learned as much through text-based learning. The most noteworthy and positive conclusion was that over 90 % of pupils were either very happy, or extremely happy, with their end product, and this applied to both the subject requirement and the layout of the novel. Many pupils stressed the fact that it had been exciting to work within an IT format instead of the usual books.

At the end of the course element, the teacher expressed great satisfaction at the level of student motivation during the lessons. The pupils worked in a particularly concentrated and effective way. One unusual thing was that they came voluntarily into the class even before the end of their break time. The teacher also highlighted the pride the pupils displayed when showing their end products during the group exhibition.

In the teacher's opinion, the most important result from these classes was the fact that the weaker pupils showed the greatest engagement. In many cases it was these students who knew the game already and were able to offer help and encouragement to their classmates. The teacher viewed the benefits which this group derived from the subject being taught in this way as being surprisingly extensive.

Patrician III

The strategy game *Patrician III* (Atari) has been used in 6th class (age 12-13) in a multidisciplinary teaching context involving History, Danish and IT. The game is set in the Middle Ages. Players play the role of a merchant whose ships ply the Baltic Sea as their trading area. The challenge is to buy goods at a low price and sell them at a high price. If a player is adept at making money, his or her fleet can be expanded, thereby obtaining greater power in the game. 25 copies of Patrician III were given to us by Multimedieforeningen and Atari.

Given that the game's cultural basis is the Middle Ages, the class worked with books which explain the background to this, whilst the teacher also gave verbal explanations. Likewise, the pupils were shown the presentation program before using the game. The aim in incorporating computer games into the course was to help pupils to broaden their knowledge of the Middle Ages generally, and to understand the kind of living conditions and power relationships which prevailed during this period (History). At the same time, pupils were required to make a PowerPoint presentation (IT) and to use this as a basis for a verbal presentation (Danish).

Study using the game lasted a total of 25 hours. As in the Sims study scenario, super-users were identified, there were a couple of lessons of free game play, and the pupils were informed of the aims behind the use of the game and the teaching schedule involved. Based on the pupils' recently acquired knowledge of the Middle Ages, and after first two lessons involving game play with *Patrician III*, possible themes were raised with the pupils, which might be suitable for use in a presentation to the class. These were written up on the board and pupils then selected a theme in pairs. Examples of proposed themes were ships, trade, towns, the Baltic Sea area, sickness and health, pirates, social groups (merchants, sailors, priests, farmers etc). The pupils worked in pairs and so had two computers at their disposal. One of the computers was used for playing the game and images from here could be saved to a folder accessible from both computers. |The other computer was used to edit the PowerPoint presentation.

As an added dimension, course instruction proceeded simultaneously at Højby School and Høng School. The idea was that pupils could share images and offer responses to each other's work. Each pupil pair at Højby School was twinned with a pair from Høng School. As the course progressed, pupils sent their project productions to each other and received comments back, which were then used when reviewing the progress of their presentation. At the end of the course, all pupil pairs put their presentations on view to the rest of the class.

The games-based approach was evaluated in much the same way as the *Sims* course and similar conclusions were drawn to those described above. Many pupils, furthermore, also placed emphasis on how much they felt the game had made them feel that they were actually in the Middle Ages. Thus, from a teacher's perspective, it may be said that the use of the game lent an authenticity which books on their own would not be able to provide. The evaluation process asked pupils to identify the biggest single motivating factor in the games classes. Here, the most frequently repeated statement was that the pupils themselves felt that they were playing an active role. Instead of adopting the usual role of listener, reader and observer, the pupils were required to create something and be proactive. Playing the role, for example, of a powerful merchant from Lübeck seemed to be a significant motivating factor in understanding conditions in the Middle Ages.

As a thought-provoking sequel to the games classes using *Patrician III*, in the following year pupils were set to do course study on the colonial period. When discussing this, they made spontaneous references to the previous year's work on the Middle Ages, and following an introduction to the power relationships in the colonial period, one student said: 'Well, I can understand that quite well. I mean, it's like that time with *Patrician*. At that time we had ships and sailed around - it was just in a different place.' Thus, for this pupil, *Patrician* had become a reference point, which could be used to get to grips with the power relationships in an entirely different historical period.

Harry Potter and the prisoner of Azkaban

The game was used in Danish 6th classes, where pupils were tasked to work on genre awareness and media skills. The pupils read the book, watched the film and played the game for the duration of two lessons. The pupils could also take the game home with them, so they could engage in free play beyond the two lessons provided at school. The teacher had compiled a series of course tasks for the pupils using the three different genres as a starting point. These tasks were designed for both individual and group-based activities. The pupils were asked to carry out a comparison of the three genres, to find their similarities and differences. Some of the project sheets required that the pupil weigh up the impression that the devices used by the three different media had upon them. One project sheet consisted of a synoptic view of the chapters in the book and the film's major sequences. Here, the task for the pupils was to meld the game into this synopsis.

The course finished with a class discussion of computer game media and their influence on the pupils' lives. The discussion was based around a number of case studies designed by the teacher. Amongst other things, the pupils discussed the different levels of gaming experience, risk factors when gaming, and parents and gaming.

The evaluation was carried out through class discussion. The following statements were made by pupils during this discussion: 'I had just not thought about why I think it's so cool to play *Counter Strike*. Now I know exactly why' (boy). 'I'd never have thought that I would become a computer-games head. But now I think I could really get into it' (girl).

At the end of the course, the teacher's assessment was that the pupils had been surprised to find that computer games could be used as a teaching tool. Some pupils had shown reservations on being told what was planned for the course. Their view was that computer games were only for play purposes and something that only should be done at home in free time. At school, you were supposed to learn using books. Once the course was ended, the pupils were handed a questionnaire which contained the question: Do you think that the use of this computer game could be described as rubbish and/or like using a kid's toy? Every pupil answered NO to this question.

Finally, where the use of this game in class is concerned, it is fair to conclude that it is now fixed in the minds of the pupils as being a suitable genre for the teaching of Danish. It should also be mentioned that weaker pupils in the class were able to participate in the class discussion, offering their opinions using different examples and arguments.

Key issues: The teacher's role and communication with parents

The incorporation of computer games in the classroom is still at the experimental stage at Højby School. One reason for this is that neither the games themselves, the methodology nor the teaching material are as yet readily available. Even though increasing numbers of teachers are making requests for course material using games, there is still a need for a consciously targeted approach before these games can become an integral part of everyday teaching in schools. All such courses involve the school librarian and/or IT leader as the coordinator and active participant in preparation, development and follow up, and also as a technical adviser and support resource. The school librarian is the prime mover, both when previously used courses are repeated in new classes, and as the initiator for courses involving new games.

One of the biggest barriers to acknowledging computer games as a new medium, a new way of telling a story which should be incorporated into school teaching, is to be found in a teaching culture and identity which stresses that a teacher must know absolutely everything about a given subject, be very skilled in that subject and always be extremely well prepared for class. However, when teachers are using computer games as class material, they will often find that the pupils will, in some areas, be more skilled than they are. A redefinition of the role of teacher is required before teachers can perceive themselves as still teachers in this new context, and accept that computer games may be used as teaching tools, without the teacher necessarily knowing all the ins and outs of one or more of the games being used. Thus, there is a need for a clarification of the teacher's role as a pedagogical scene setter and not as a confirmed computer gamer.

Despite the many barriers that still lie before us, we are very positive about the future with regard to the use of computer games in teaching. This is due in no small part to the positive and open support we have received from the school's board of management. It should be emphasised that we are always at pains to keep parents informed with regard to all aspects of classroom use of computer games. Parents are apprised of the desired goals for each subject and informed of the results from the subsequent evaluation. When such class work involves larger-scale projects for the pupils, parents are able to follow the progress of their child's work via the school liaison group. The parents have registered substantial support for classroom use of computer games.

Further information:

Some of the learning resources referred to above can be found on the EMU website (National online teaching resource):

- for teachers - http://www.emu.dk/gsk/tema/spil/index.jsp
- for pupils/students - http://www.emu.dk/elever7-10/projekter/computerspil/index.html
- blog for computer games - http://weblog.emu.dk/roller/enis/category/Computerspil

The Consolarium, Scotland, UK

Leading the practical exploration of games-based learning in Scottish schools

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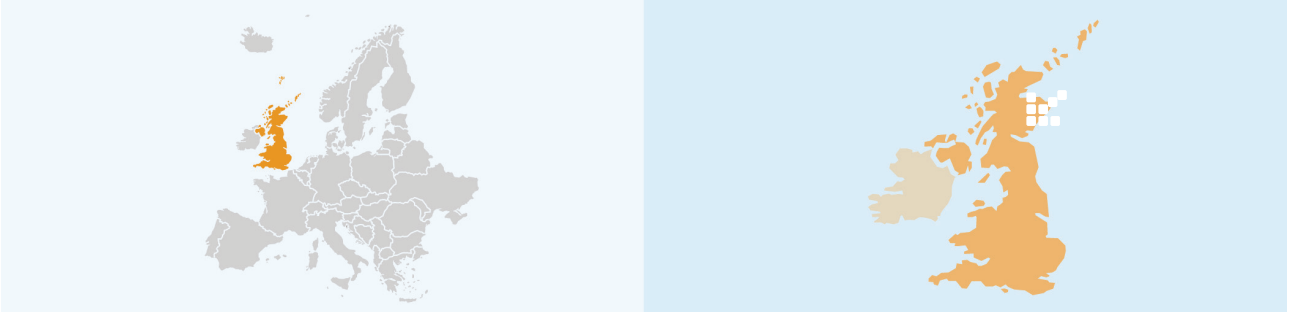


Computer games in the classroom - you can't be serious?

Computer games as learning tools, who'd have thought it? Those modern day folk devils that up until recently have lurked in children's bedrooms are now not only sitting centre stage in living rooms but also, now in classrooms! What on earth is going on you may ask? What has a game for the Wii, PS3, Xbox360, DS or PSP got to do with the world of learning in school? Aren't these machines just frivolous time wasters that induce cognitive stagnation, cause obesity and turn our children into bedroom dwelling loners? Can these machines have ANY place at all in the teaching and learning dynamic in the modern classroom? Well, at Learning and Teaching Scotland and in very many of the schools and classrooms that we work in, the answer to that question is most definitely yes!

The Consolarium: a national resource to explore games-based learning

Learning and Teaching Scotland (LTS) is a public body sponsored by the Scottish Government Schools Directorate, responsible to Fiona Hyslop, cabinet secretary.[10] It is committed to providing world-class teaching and learning experiences for Scotland's children and young people. As the lead organisation for curriculum development in Scotland, we offer support and guidance to teachers, early years practitioners, schools and education authorities to help improve achievement for all.

A recent addition to this service has been its initiative to explore the benefits and practicalities of using computer games in schools. This has led to a number of innovative projects happening in schools in almost all of the 32 local authorities across Scotland, which have emanated from our games-based learning centre in Dundee – The Consolarium. This initiative has been established in order to:

- Explore the range of games technologies available and in doing so practically and theoretically inform and influence curriculum development for the 21st century;
- Provide a space where teachers and others involved in education can visit and get hands-on access to these resources;

- encourage teachers and educators to engage with the debate about the place of such technology in their class, school or local authority;
- reflect on how 'out of school' learning can be encouraged and maximized;
- develop relationships with local authority, academic and industry partners to extend, and refine effective and innovative practice with computer games.

This centre has recently been relocated from LTS's Dundee office to the University of Abertay in Dundee, a university that in February 2009 became the UK's first ever university centre of excellence for computer games education and has received a £3 million investment from the Scottish Government.

Does good game design sometimes mirror good educational practice?

Most of the initiatives that we have undertaken in the past two years have involved the practical application of commercial, off-the-shelf games available for the Wii, DS, PS2, PS3, PSP and the Xbox 360. Many, if not all, of these games have most certainly not been designed for traditional educational purposes; that is, until you look a little closer and see the complex and engaging learning environments inherent in many of them. In fact, if you take a closer look at the world of commercially available computer games that you can buy from any high street store you may find yourself disarmingly surprised at how these resources, which are great fun, are actually designed around the principles that underpin effective teaching and learning.

Good teachers know about creating contexts for learning. This may take the form of a collaborative story or a process of enquiry that provides a supportive framework with which a teacher can build on what learners already know and can do, in order to move them forward and continually bridge the zone of proximal development. Good teachers know about differentiation, adjusting the learning to suit the abilities and pace of a learner. Good teachers know about progression and continuity that allows the learner to develop a skill or knowledge set from the position of novice into that of someone with mastery and confidence in what they have been learning. Good games do all of these things and more, and in the hands of imaginative and innovative teachers they have the potential to do great things.

How are we using some games?

In schools in Scotland we have been working with very many teachers (roughly 500) to retro-fit commercial off-the shelf games into the teaching and learning that happens in nursery, primary and secondary classes. This means taking a game that was not originally designed for education and adapting its use so that it can be used to address educational needs and aspirations for learning. Two of those approaches have used games for the Nintendo DS. These are:

- Dr Kawashima's Brain Training
- Nintendogs

Dr Kawashima's Brain Training

Dr Kawashima's Brain Training is a game made for the Nintendo DS. It is based around a number of challenges that are embedded in numeracy and literacy as well as memory. As the player engages with the challenges the player's profile is established and their performance is tracked through a feature called the Brain Age. The better you are at the game then the lower your Brain Age.

In April 2008 we carried out randomised controlled trial (RCT) following on from a small-scale case study (Miller & Robertson, under review) that we conducted in partnership with the University of Dundee. In that study, we found statistically significant improvements in computation (accuracy and speed of processing) and self-perceptions when children used Dr Kawashima's Brain Training for 20-25 minutes each day over a ten-week treatment period. LTS was again partnered by Dr David Miller from the University of Dundee for the extended trial as well as representation from Her Majesty's Inspectorate of Education, who had expressed a keen interest in the results of our initial small scale study.

The design of this trial involved identifying schools which were in the lowest quartile in terms of socio-economic status (as measured by entitlement to free school meals) in each of the four participating Local Authorities; The Western Isles, Aberdeenshire, Dundee City and East Ayrshire . Once the pool of schools had been identified in each authority, they were randomly assigned to the experimental or control group. Each school in the experimental group was given a set of Nintendo DS Lite games consoles for a primary 6 class (10-11 year-olds).

The initial small-scale study was carried out in three schools with only one of those using the Dr Kawashima game. The extended study had much more reach. The sample in this case involved 32 schools from four local authorities. Our final sample size was complete data for 634 children.

What was our methodology?

- We decided to use a randomised controlled trial (stratified random sample) over a treatment period of 9 weeks.
- There were 2 conditions to this:
  - Experimental group, who used the Nintendo 20-25 minutes a day, 5 days a week playing Dr. Kawashima's Brain Training with one Brain Age check on a Friday afternoon
  - A control group, where the teachers were asked not to change their normal routine

In order to support the teachers' understanding of what was required, a training session was provided for the teachers who were in the Nintendo group.[11] This involved a brief description of our rationale, methodology and a workshop on how to set up a player profile in the game and how to begin playing it. It was stressed to the teachers that it was very important that they followed the required methodology.

Before the trial began every school was visited and pre-measures of computation (accuracy and speed) and various self-measures (e.g. mathematics self-concept) were given to the children. The computation measure took the form of a written numeracy test aimed at Scotland's Mathematics 5-14 Level D standard. This

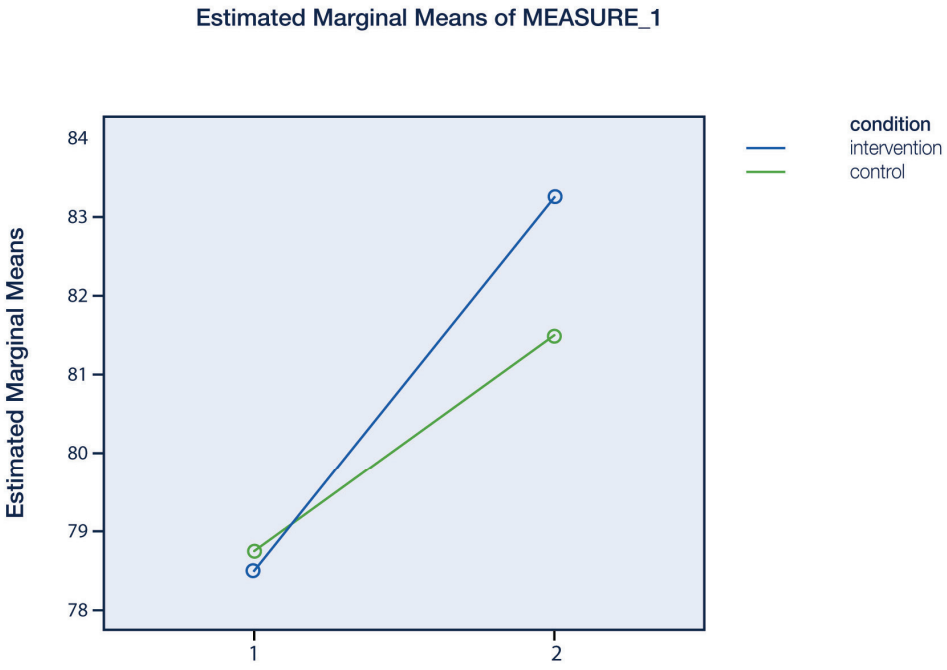
involved mental addition and subtraction under the number 100, as well as multiplication and division sums, up to the 11 times table. The children were timed doing this test and they were not informed of how they performed. In addition, other data were collected, e.g. children's previous performance against national standards (5-14 levels); computer use at home. Post-measures were taken using the same materials at the end of the trial.

What did we find?

1. Accuracy (number correct)

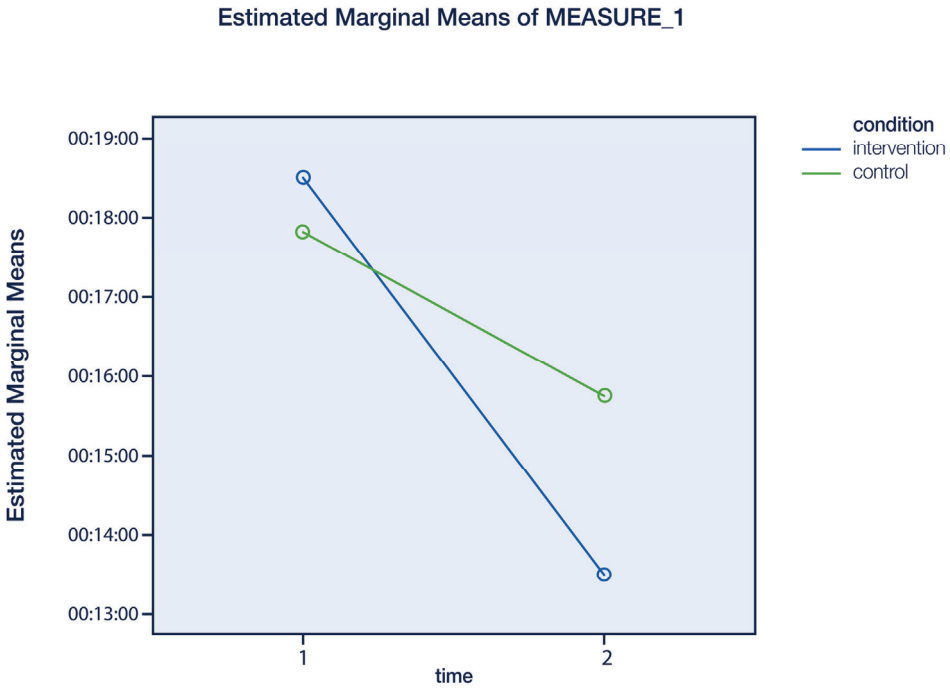
Our results indicated a statistically significant gain in both groups in this area.

What was of particular interest to us was that the mean gain in the experimental group was approximately 50% greater than that of the control group. This difference was statistically significant.



2. Speed of processing (time taken to complete number test)

Again, our results indicated that there were statistically significant improvements in both groups in this area. However, the mean improvement in the experimental group was more than twice that of the control group. This difference was highly statistically significant.



3. Self-concept

Our data indicated no significant change in either maths self-concept or academic self-concept in either group.

4. Attitude to school

Our data indicated a slight – but statistically significant – improvement in attitude towards school in the experimental group, but not in controls. How some of this change in attitude was manifested is documented in the 'Further comments' section below.

5. Analysis by previously recorded mathematical ability (general trends)

In terms of accuracy in the written maths assessment our results showed that the less competent children tended to improve more than the more able children. This was in line with what we found in our initial small-scale study.

In terms of the improvements in the speed of completion of the written maths assessment our results indicated that the majority of children in the middle of the ability range improved more than the children at the top and bottom.

6. Gender

We were interested in whether there were any differences in performance/impact of this intervention on boys and girls. Our results indicated that there were no significant gender differences.

Some further comments

In addition to the quantitative data collected, we also noted comments from teachers and children after the treatment period was over. Of particular interest were the comments about how Dr. Kawashima nurtured a collegiate ethos in class. The game created a climate where the pupils were sufficiently interested in what their peers scored to the extent that there was a desire to better them. However, what is of more significance is that there appeared to be a much stronger intrinsic motivational drive for continual self-improvement through their individual profile and the relationship with Dr. Kawashima. There was also evidence that shows how learners developed an awareness of what they needed to improve and what strategies they would have apply to do this: meta-cognition in action. Teachers and Senior Management commented on how the children were encouraging and supportive of each other and of how they felt it bonded them and brought them together as a class. When some children were asked about how the project had helped them as an individual with their mental maths it was most common for the child to conjugate their responses with 'we' and not 'I'.

Further qualitative data will be reported in due course, but some interesting findings included:

- Improvements noticed in children's academic work: tables, basic computation, writings
- truanting and lateness had dramatically improved in some classes (the Nintendos were used at the start of the school day)
- positive impact on behaviour (children argued less amongst themselves and were quiet, concentrated and focused while playing the game)
- children keen to take responsibility for the management aspects (collection, distribution, charging, etc.)
- improvements in interpersonal relationships (children taking a supportive interest in the performance of peers)
- children believed that they were 'smarter' as a result of using the game

Final comments

There are many implications here: for the use of commercial off-the-shelf games in classrooms, for the raising attainment agenda, for teaching and learning styles, for further investigation of the domains of learning, for the management of electronic resources once purchased, for teachers' belief systems, and a range of other issues. These will be developed in more detail in our forthcoming academic papers. At this point we would like to make two concluding remarks.

1. When interesting educational innovations appear, or new and exciting equipment becomes available, these are occasionally (but not always) trialled in schools. However, this evaluation process is rarely rigorous. For example, 'good' schools and/or enthusiastic or ambitious teachers are often targeted to trial materials or equipment. 'Hard data' are not always collected. Comparison groups are rarely – if ever – employed. From the point of view of objectivity and generalisability, the dangers of such an approach are obvious. This becomes a real issue when one begins to comprehend the spending nation-wide on new curriculum materials and resources.

   We believe that the value of this RCT is that it supplies us with objective data, and provides a realistic picture of the results we might expect to see across the primary school population in Scotland.

2. Finally, we wish to emphasise that the funding for this study was provided mainly by Learning and Teaching Scotland (a non-departmental public body funded by the Scottish Government), with one of the participating Local Education Authorities contributing to the cost in order to spread the use of

these resources in their authority. The authors neither asked for, nor received, financial or any other form of support from Nintendo or any other commercial organization.

Nintendogs

Nintendogs is a game for the Nintendo DS. In this game you take ownership of a puppy dog and from then on you are responsible for looking after it. This responsibility means that you have to ensure that your puppy is healthy, happy and well exercised. You can also train your puppy and take it to competitions where the dogs demonstrate their prowess at catching a Frisbee, their ability to recognise and respond to voice commands from their owner and their skills in a dog agility trial. Success in these competitions brings financial rewards that the player can then spend in the in-game shop on water, food, shampoo, toys, clothes, brushes etc. for their dog.

On a recent visit to a P.2 class (6 year-olds) in Aberdeenshire, I was met by a young learner who asked if I'd like to meet her dog. "Chloe, Chloe...", called the excited learner. On hearing its name, the dog duly bounded towards its owner, barking and leaping about with excitement. But don't worry, there are no health and safety issues here, no need to sweep up dog hairs or to even open a can of dog food. These dogs are not real. They are virtual dogs appearing in the game Nintendogs for the Nintendo DS, and they have been used to create a rich, dynamic and inclusive educational context for the hungry learners involved in this games-based learning initiative.

Are we barking up the wrong tree here? You might wonder whether using computer games in the classroom is just an example of the tail wagging the dog. Are we losing sight of what has traditionally been viewed as 'teaching'? Is teacher authority further undermined by the integration of technologies that sit comfortably in the cultural domain of young learners? Well, at Learning and Teaching Scotland (LTS), we don't think so…

Looking a little closer at one of these games is exactly what two non game-playing teachers from Elrick and Banchory primary schools in Aberdeenshire did when we asked them to join with us on our proposed Nintendogs project.

If you remember the Tamagotchi[12] craze then you are some way to understanding Nintendogs. The game involves the player creating or 'giving birth' to their dog! After this happy event, they must take responsibility for their canine creation's well-being. The player/learner needs to train their dog to recognise its name, they have to feed their dog, ensure that it is well exercised and that it is loved and played with. They can then train it to sit, lie down, roll over and even run and catch a virtual Frisbee with the eventual challenge of applying all these newly mastered skills in dog training competitions. These competitions vary in complexity and provide the opportunity to win money, which can be spent on your dog in the virtual shop. You might even get enough to buy your Chihuahua a fireman's hat!

Both teachers used the game as the central focus of a cross-curricular project, making it the contextual hub that drove the learning. Caring for and nurturing your virtual pet is central to this game, so it became central to the project. In order to do this, the children were put into groups of three so that they could work together and ensure the all round well-being and needs of their dog were being met.

Although projects involving Art & Design, Drama, Citizenship and ICT were undertaken, here are some detailed accounts of what the children did and how the game impacted on their learning :

Motivating reluctant learners – *Nintendogs and Literacy*

In both classes, the pupils kept Doggy Diaries. This was the place where the children voluntarily wrote about their dog's exploits in the game. Whether recording how their pooch performed in the Frisbee catching competition, or how it felt after being fed, exercised or petted, the children's Doggy Diaries became an integral part of the day. Most importantly, they involved the children *choosing* to write.

Both teachers commented on the boys' increased levels of engagement in writing. They felt that the context of the game and the desire to tell the story of their dog was a real driving factor. One concern that critics of modern technology and media invariably raise is that children are not choosing to read books any more. In this regard, the project had the opposite effect. The book corner was packed with fiction and non-fiction about dogs and was a hugely popular resource with the children. They embarked upon projects about Hairy Maclary,[13] found out all about Crufts[14] and they even knew that Laika was the first dog in space! Information about dogs and all things doggy, in books or on the web, was eagerly sniffed out and consumed by the children.

Making learning relevant – *Nintendogs and Design & Technology*

As well as having your virtual pet, you can also buy fluffy, cuddly versions of your favourite Nintendog. These were put to great use in design and technology. One class had to make a kennel for their dog that would keep it dry and warm. The learning intention here was to investigate the properties of materials that would help build a good shelter. Embedded in such a relevant and meaningful context, the activity proved to be a rich learning experience.

The other class did a similar task that involved the design and creation of a bed for their dog. Again, the activity's relevant and meaningful context resulted in a whole-hearted and enthusiastic approach to learning about materials, as the children were keen to ensure their dog would be cosy and comfortable.

Developing a learning community – *Nintendogs and ICT*

In Scotland we are developing a Curriculum for Excellence and its four purposes are to create:

- Successful Learners
- Confident Individuals
- Effective Contributors
- Responsible Citizens

A major aspect our new curriculum is the need to focus on the creation of a learning culture in which everyone can thrive. This is what happened in this project. A blog was created in both classes – the idea being for young pupils to communicate their learning in class to the wider community. Helped by P.7 children (12 year-olds) to scan in their drawings and type in their text, the children found that people outside the school, such as family and friends as well as the local community and businesses, were very interested in what they were doing. Pupils could see a purpose for their work: they had an audience, and this audience offered them supportive and formative feedback. The children saw that they were very much an active agent in the learning process.

This was further complemented by the Top Dogs peer-tutoring scheme, which involved children who already knew how to play Nintendogs becoming the tutors for those that were new to the game. The experience of becoming the teacher proved to be enriching, particularly for some children who struggled to keep up with their peers in their everyday class work. The whole culture within this project focused on and nurtured the active participation of learners in their learning. It helped the children to understand that they are the most important person in their learning journey.

Both teachers could not believe the impact that a commercial off-the-shelf game had on their children. It must also be said that neither could the children's parents, who after some initial reservations and concerns about this project became glowing advocates of such an approach due to its positive impact. So much so that one family made a donation of £1000 to the school so that it could buy more games to use with other children.

Resources that resonate with learners from the digital age

The pupils that we work with, test or interview talk enthusiastically about learning through games. Reluctant writers talk about being inspired to write because of the worlds of the games and the images that they find themselves immersed in. Children identified as having lesser ability in maths are observed to be more confident and able in mental maths. Teachers talk about children buying in to learning through games because it's something that is from their world.

We need to ensure that school is a place that children want to be. Education systems need to continually reflect on the experiences that they present for increasingly tech-savvy and expectant students. School, as it is, works for many children but it clearly doesn't work for many others. Our work with commercial games may have its success embedded somewhere in the idea that we are somehow meeting children on their own terms by introducing what we want them to learn in the context of something that sits comfortably within a domain that they belong to, a domain in which they have ownership, mastery and expertise. For many children the domain of the computer game is one in which they are very comfortable. But for many children school is to some extent a domain in which they are a visitor. Shouldn't learners be resident in the domains in which their learning takes place? If we can somehow enable these domains to intersect then maybe we can re-engage the learner for whom school isn't working and ensure that they are at home in school. We are finding that games are helping us do this.

The teacher is at the heart of such an approach

Let's not forget the importance of the teacher here, though. The teachers that we work with talk in the most excited and animated fashion about the learning that has been happening in their class via games technologies, and how much they have enjoyed what has been happening. What they don't talk about are the technical difficulties and worries that many teachers experience when using traditional ICTs. Why is this? What is it about games that is enabling a 'focus on the teach and not the tech?' Almost all games consoles have a low technology skills threshold. You get almost instantaneous success when using a games device. A user-friendly-interface engaging game structured around context, differentiation, progression and continuity ensures this. If only all ICT in-service and Continuing Professional Development was this easy!

The Consolarium's experience demonstrates that games offer powerful, dynamic and relevant contexts for learning. If their informed application in classrooms by thoughtful and imaginative practitioners can enliven learning and help switch children on to achieving their potential and schools to meeting the needs of learners via non-conventional yet effective ways, then they are a valid and valuable resource that we need to explore in greater detail and depth.

Get the games out – you may find that there's more to them than you may have first thought.

Further information:

The Consolarium

http://www.ltscotland.org.uk/ictineducation/gamesbasedlearning/

Dr Kawashima's Brain Training initial small scale case study

http://www.ltscotland.org.uk/ictineducation/gamesbasedlearning/sharingpractice/braintraining/introduction.asp

Dr Kawashima extended study summary

http://ltsblogs.org.uk/consolarium/2008/09/25/dr-kawashima-extended-trial-summary-results/

Guitar Hero case study

http://www.ltscotland.org.uk/ictineducation/gamesbasedlearning/sharingpractice/guitarhero/introduction.asp

Endless Ocean in the classroom

http://ltsblogs.org.uk/consolarium/2008/11/15/endless-ocean-and-endless-learning-in-stirling/

Nintendogs in the classroom: Consolarium blog

http://ltsblogs.org.uk/consolarium/2008/03/22/fantastic-learning-in-p2-via-nintendogs/

Nintendogs in the classroom: Handheld Learning case study

http://www.handheldlearning.co.uk/content/view/46/1/

Derek Robertson demonstrates Dr Kawashima and Nintendogs at Handheld Learning 2008

http://www.handheldlearning.co.uk/content/view/53/82/

http://www.ltscotland.org.uk/ictineducation/gamesbasedlearning/

Farm Frenzy, France

Serious games as a remedial strategy in a secondary school in Privas, Ardèche

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Certain games are recognised as having a positive and intellectual image in the collective unconscious. The majority of people regard Chess and the game of Go as a fulfilling exercise for the mind. Video games, on the other hand, suffer from a poor image arising from a generational gap. Yet they constitute a part of young people's everyday lives. As such, we ought to embrace them as an opportunity in order to reach our pupils.

Digital natives find it increasingly hard to concentrate on a task for a sustained period, or compelled to undertake repetitive review exercises. As a consequence, without a solid base or tools to compensate, many children resign themselves to failure at school and can even develop didaskaleinophobia (school phobia).

Our experiment uses video games to unlock this situation. To play an instrument well, one has to learn to read music and invest long periods of time in practising scales. We see games as a useful way to practise, with enthusiasm, the "scales of complex tasks in school subjects".

How did the project develop?

The initiative was taken by a teacher (Florian-Pierre Grenier) and carried out in a rural secondary school of 700 pupils in southern France, in Privas, Ardèche.

The school is very dynamic. Teachers are encouraged to take initiatives to support their pupils through the use of personalised programmes for educational success (PPRE). This institutional open-mindedness gave way to the preparation and fulfilment of the project.

The aim was to offer support to pupils experiencing serious difficulties, as much as for their academic results as their socialisation.

We worked with a group of six pupils from different classes in the year-group of 11-year-olds. The aim was to pursue a remedial programme based on "serious games" and key skills. The idea was to put together a training programme made up of several games, each targeting one of the child's problem areas. The group retained a shared activity on one game, followed by a debriefing at the end of each session.

Only one teacher, of biology and geology, was directly involved in the project and in direct contact with the pupils. This teacher has also been co-ordinator of ICT and SVT for the education authority of Grenoble for the past five years. As a long-time player of board and screen games, he knew the range of available games well enough to select those that seemed useful for this project. The other members of the teaching team

had followed the progress made in their respective fields and were responsible for promoting the skills gained from the pupils' work from the games.

The project's flagship games

Several games were selected, with two assigned per pupil. The game *Farm Frenzy* (Big Fish games), the key element of the experience, was used by everyone. The other games included Nintendo's *Big Brain Academy* (to connect with evaluation), *My Word Coach (*so that students may expand their lexical field and become accustomed to progressive learning), and *Text Express (*to work on decision-making and vocabulary). Each of these games was played for ten minutes. Their selection was based on the same criteria as *Farm Frenzy* (which will be explained further below). Each game generates a strong emotional involvement, which produces a certain level of anxiety contingent on the child's current state. The stress involved ought not to be feared, but embraced as an opportunity to help children manage it effectively. In this respect, it ought to be taken into consideration.

Farm Frenzy is an amusing simulation of a farm's operational activity: from tending the fields where your cows graze to gathering eggs for sale at the town market. The money you earn has to be invested on new equipment in order to upgrade your farm. For example, you could build a dairy for the production of cheese, allowing you to process your milk on the premises, thereby increasing your revenue. In order to reach the next level in *Farm Frenzy*, you must complete a specific task, such as producing a certain number of eggs. Each new level is progressively more challenging, meaning that you must increase the capacity of your warehouse and improve the performance of your production facilities. You can even buy a larger lorry in order to deliver more goods to the market. The level of difficulty increases throughout the game's 45 levels.

The game is available as a demo version, a licensed version, as well as an online Flash version. It is the latter that we used with respect to this project.

This game provides an opportunity for much discussion and requires many of the skills listed within the section of "scientific and technical culture" of the common base of the teaching programme.

Playing can be hard work

Farm Frenzy aims to improve pupils' methodological skills. An eight-week training programme was offered to a group of pupils who shared similar difficulties. Use of the game, followed by "debriefing", took place in the science room every other day, for twenty minutes throughout their lunch break. Each child played on their computer for ten minutes, before engaging in a discussion with their teacher about the selected game strategy. The other ten minutes were dedicated to another game, specific to each child. Most of the pupils from this group no longer saw school as a factor of social progression; they merely suffered and spent a lot of time there without achieving anything. They were weary and discouraged by the fruitlessness of their efforts.

The teacher had extensive experience with games such as chess, pool, trading cards and video games. This fuelled his desire to create an alternative approach to learning for these young people. From this point of view, *Farm Frenzy* is simply a tool used in non-traumatising remedial teaching, based on appreciation, rivalry and discussion – but a useful tool. With help from the teacher, a child who gains competence in a particular area can transfer that competence into an academic context. This ideal was difficult to accept for other teachers who believed in the old saying "no pain, no gain". But it should be remembered that in Ancient Rome, *ludo* meant both "to learn" and "to play".

It was first necessary to motivate pupils whose withdrawal from the academic system led them to think that they were too "stupid" for school and that they were being given games just "to keep them busy". It took time to explain to them how games could help them. With this in mind, the metaphor of the piano and practise of scales was very useful. It was for this very reason that we chose to name these moments as support sessions, scheduled as a supplement outside the normal teaching time. Pupils particularly appreciated this "recognition".

- *Week one:* Pupils discovered the games by themselves. By the end of the week, they discussed their objectives with their teacher. Together, they decided to finish the game within the term.
- *Week two:* the teacher's objective was aimed at stimulating a change in pupils' minds so that they may ask themselves questions such as "What am I supposed to do?" – but also "How can I…".

  By the end of this stage, the parallel between the scientific approach and that required by the game was established:

Experimental approach	Game method
Initial situation	Game scenario
Problem	How to achieve the targets set by the game
Hypothesis	Planned strategy
Experimental test	Game session
Outcome	Overcoming an obstacle (or not)
Interpretation	Do I have an effective strategy; is it the best one? (score)
Conclusion	What can I use in the next level

- *Week three:* introduction of competition and rivalry. From this week onwards, e third week, to keep the group motivated, it was necessary to make explicit the teacher's monitoring of the pupils in terms of progress in skills, again with the aim of situating the games in an educational framework.

- *Week four:* Once level ten is reached, pupils cannot go any further without receiving help. They seek advice from one another within the group. They exchange ideas verbally while remaining in their seats. They are also allowed to move around and discuss freely, but are forbidden to play for one another.
- *Week five:* Pupils decide to reach one level after the other, while comparing strategies. Some even suggest searching the web to access cheats or tips in order to increase their level of success. However, the group rejects this idea for lack of time spent on the game itself. A forum type mechanism emerges within the class.
- *Week six:* Pupils begin to track a strategy log. They want to record their gaming experience in writing. However, word-processing and image pasting proves to be far too time consuming, leading to tensions.
- *Weeks seven and eight:* They continue playing while discussing the effectiveness and selection of their strategies, time-management, etc.… in short, how to organise themselves. In these last two weeks, pupils address very abstract concepts such as criteria and indicators of success. They ask themselves questions such as: “How can I determine whether I am doing well?” –– These questions allow the teacher to draw conclusions to be included within the self-evaluation forms used in class.

Within the first three weeks, the teacher’s role was to monitor pupil’s time and stress management, bearing in mind that their emotional involvement was difficult to manage. Throughout the following three weeks, the teacher provided support through expression and discussion. In the last two weeks, the teacher insured the transfer of knowledge: during the science course, he asked pupils to come up with a strategy to counter a daily situation. Each pupil accomplished the task successfully.

Results

The experiment proved to be a success for those in the group who demonstrated the ability to improve a range of skills and competences. For example:

- By the end of the experiment, a pupil, who suffered from didaskaleinophobia, agreed to collaborate with other pupils as part of a group;
- Another, who experienced difficulties in science due to poor organisation and lack of discipline, developed leadership skills by the end of the eight-week period.

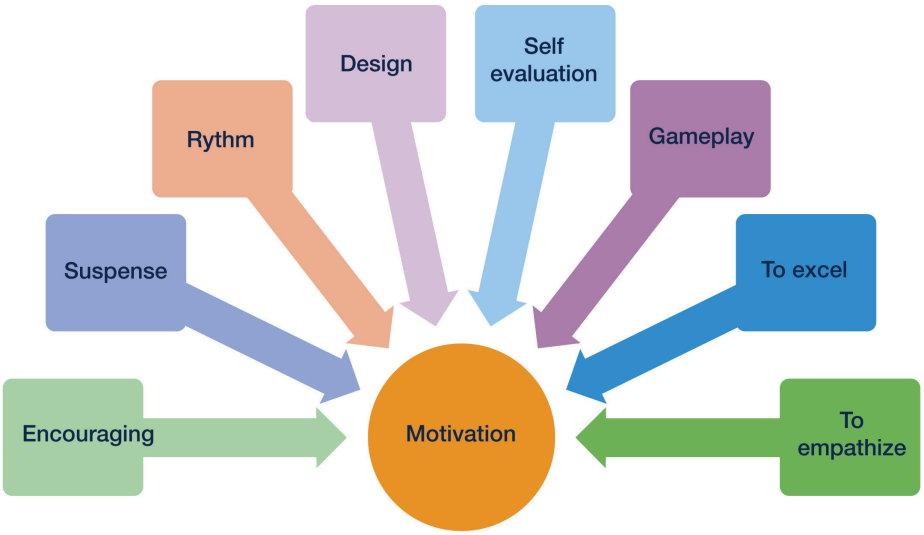
Below is a breakdown of the acquired skills:

- Critical awareness: These pupils not only learned to critically analyse their own approach, but also to accept their teacher's feedback as constructive rather than discouraging.
- Logical thinking: As they reached one level after the other, the pupils grew familiar with the complex tasks, learning to differentiate actions from their consequences and concepts from their meanings. With this focus in mind, they improved on all subject levels.
- Social skills: the main purpose of the game is social; the pupils have to abide by a set of rules and conventions in order to play together. By promoting and encouraging these abilities, the pupils learned to develop social intelligence that taught them to better understand the conventions of group integration. Although its scope is difficult to measure, this point is an important one and has a significant bearing on the assessment of learning.
- Learning outcome: Because pupils feel more confident at school they are able to concentrate attentively, making it easier to learn. It is difficult to determine whether this outcome is due to the adoption of games or simply a decreased feeling of didaskaleinophobia.

By the end of the experiment, the pupils who took part were more confident, no longer afraid of evaluation and enjoyed working in lessons. The teacher attributes these outcomes to the following factors:

1. A very appealing game: the game is attractive, easy to assimilate and fun to play. This argument bears an important significance: games in which the educational value is cleverly disguised by aesthetics (in which case, the game is deemed unsatisfactory) should be avoided in favour of real games, which develop skills that may be used within the academic context. The "fun" side should be embraced if it is to include the intellectual satisfactions such as problem-solving or the mastering of elaborate procedures, as those found in *Flight Simulator.*
2. Clearly defined goals: In a visual context, command of language should not constitute an impediment to understanding, especially at the beginning of a new level.
3. A different level of command to be achieved for each level of the game: each goal is lessened and allows a distinction to be made between "satisfactory" and "exceptional", while giving credit for every achievement.
4. Effective Gameplay: elaborate tasks, gradual levels of difficulty, tricks, etc. The levels are structured into simple complex tasks rather than complicated simple tasks. Some parts of the game are merely lures aimed at distracting the player, who is responsible for filtering information in order of relevance. In the event of failure, the player is sent back to an earlier time in the game. This provides an opportunity to recover a sense of achievement, since he or she has to attempt to overcome revisited barriers.
5. The fact that the player cannot really be defeated but that each mistake is accounted for and results in a waste of time. Failure is always penalised, without pretence. Yet its consequences are diminished. This enables players to feel that success is within their reach, even if they have not yet attained the required level.
6. Each achievement is rewarded by a "medal", even when it is not directly related to the task. This is a crucial point. Credit is given at all times, regardless of whether things seem to have a bearing on the achievement of goals. What is rewarded is the investment that the player puts forth in acquiring additional skills. The medals in *Farm Frenzy* or the system of heroic deeds in *Word of Warcraft* are both exemplary illustrations of this encouragement.

7. Ranking of scores: It is comforting for the player to be ranked in a group, as the promotion of competition is not excessively enforced. With accompanied support, the classification scheme enables the player to set personal targets, such as overtaking another or simply beating his own personal score. Moreover the player-tracking systems developed by video games provide an evaluation that can always be improved, provided it is comprehensive, contextualised and related to the time of play.



Difficulties were also encountered

Identifying games

The wide diversity of games on offer both eases and complicates the selection process. In order to select a game, one should of course have tested the game, but also be capable of retaining enough distance from academic skills to be able to recognise them within. Licensing and hardware support can also become an issue.

Offering a different training programme, with different games

In this project, it was essential to make a clear distinction between the perspective of “work” and “play”. Therefore, we found it best to require that several games be introduced in each session. Frustration arising from the teacher’s time management made it possible to remain within the domain of learning. As is the case throughout any lesson, one has to establish a sense of uniformity between activities in order to retain momentum. The compatibility found within games is hard to find, let alone identify, other than through the teacher’s own experience.

Initially, it was difficult to persuade other teachers of the experience’s effectiveness. However, the final results were compelling. Yet a number of colleagues were alarmed by the project. They feared that ICTE would be further implemented. With little knowledge or command of these tools, they fear a possible loss of the traditional patriarchal status the teacher currently upholds. Above all, they fear a lack of perspective on practices which they are not certain to be beneficial for their pupils. These fears, which experience has

shown to be unfounded, are honourable inasmuch as they arise from their concern for their pupils. Again, one had to pay attention to academic methods and invite these teachers to take part in sessions, with the possibility to conduct them outside teaching hours so they could get to grips with the material. These events were rich in discussion and learning methods, and in most cases ended with the acceptance of the notion and term “teaching through games”. The time devoted to this explanation is essential to the expansion of the project.

What can be expected of a pupil at the end of a lesson? We are accustomed for pupils to supply a text or diagram at the end of our lessons to demonstrate their acquired knowledge. Yet within this project, the learning process is entirely centred on skills. How can we verify what has been learned? The strategic guide was an encouraging attempt, but, given the pupils’ difficulties, it would have taken too long to implement and compromised the time allocated to the project itself. By contrast, with this group of pupils, we consistently stated which game skill would be useful in classroom work at the end of each debriefing. For example: “Before I start, I need to work out what stages I want to complete, and spend enough time on each of them” (Rémi, age 11).

What comes next?

This method of teaching radically redefines the role of the teacher. Acting as a specialist to determine and evaluate the child’s difficulties, the teacher is also responsible for selecting the games. As an expert of educational methods, it is their role to incorporate these games into a remedial programme. These two dimensions are inseparable and cannot be ignored.

In the course of the coming weeks, the teacher should monitor the pupils’ behaviour and performance in order to constantly readjust teaching methods. This approach entails a holistic vision of the situation and a dynamic conception of the learning progress in learning. From this point onwards, the ideal of child-centred teaching is displaced: serious games provide pupils with an active role in constructing their knowledge, and by doing so, act as teachers themselves. The teacher then accompanies pupils in their own meta-cognitive procedures as a disciplinary and instructive resource.

The enthusiasm manifested within these sessions, pupils’ autonomy and the impact on other academic subjects pushes the desire to explore other possible video game applications. The next step would certainly include the promotion of specific knowledge. Teachers and video game designers ought to get together to create software that would combine best practices throughout the two philosophies in order to increase our pupils’ chances of success.

The DANT/IPRASE project, Italy

A 4-year “learning by playing” research-action project initiated in the Trentino Region

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About the initiative

DANT stands for “Didactics assisted by New Technologies”, an experimental project developed by IPRASE (Provincial Institute for Educational Research, Training and Experimentation). IPRASE carries out studies and research and publishes documentation in the pedagogical, methodological and training fields. Its main goal is to supporting innovation and autonomy in schools and networks of schools, promoting school evaluation activities.

DANT is an operative programme of the Autonomous Province of Trento - objective 3 for the period 2000-2006, also financed by the European Social Funds and private partners. DANT is concerned with the professionalisation of teachers and other providers of the education system, in relation with the use of new information and communication technologies as supports to didactics and learning processes. In the first phase, “Learning by playing”, one component of the DANT project, involved schools (primary and lower secondary) only in the province of Trento (more than 600 teachers and their classes). Since the school year 2003-4, DANT has involved teachers and thousand of pupils from all regions of Italy (except Valle d’Aosta). In 4 years, more than 1000 teachers joined the experimentation project involving altogether over 10,000 pupils.

The starting point of this experimental curricular project lies in several self-evaluation activities which, in the past, identified a significant group of pupils (around 20% in the Trentino region) with gaps in learning in basic mathematics and (Italian) language at the end of compulsory education. Pedagogical reflections on this fact followed and a question that arose became the first hypothesis: does ICT offer something more than traditional instruments, such as books, that is more relevant to pupils reaching low attainment levels with traditional didactics? So, IPRASE activated a reflection on the pedagogical and didactic aspects of these activities, in order to understand how to manage them in the daily teaching/learning process.

Testing the impact of using games in the teaching process on pupils’ attainment has been the core of the project, together with developing a community of thinking and research between teachers to exchange experience, good practices and materials. Within this view, various (educational) games have been designed on an ad hoc basis, tested in concrete situations by teachers, improved accordingly and then disseminated to be used on a larger scale. All the materials developed under the framework of the project, including the didactic software, have been planned and realised by a research group, made up of IPRASE coordinators, teachers, technicians and experts in ICT education.

With a view to identifying under what conditions and circumstances ICT use is able to improve the learning and motivation of pupils, the guidelines of the project have been:

- To invest in developing activities, material and proposals targeting primary education as a priority,
- To concentrate mainly on key skills and fundamental knowledge at the core of the curriculum, i.e. in mathematics (logic, written and quick mental arithmetic, trigonometry and problem solving) and Italian (spelling, syllable differentiation, etc.)
- To propose really innovative materials supporting sensory-motor learning through the use of games and simulations instead of a symbolic-constructive approach through books and lessons.

The project has been designed in terms of scale and length so as to make it possible to evaluate material and approaches developed by the research team and measure their impact on pupils' learning.

About the teachers targeted by the initiative

The DANT project covered compulsory state education only and targeted primary and lower secondary teachers who especially taught Italian, Maths, Geography and Science and who did not necessarily play a leading role in ICT in their schools ICT. They had teaching competences in one discipline (especially secondary teachers) or more (especially primary teachers).

Since Italian teachers have very different levels in ICT literacy, it was very difficult to draw a profile of this; consequently, the PC-based games provided by IPRASE were made available on auto-play CD-ROM. This meant that only a very low level of ICT skills was required.

The work of the research group has taken into account the outcomes of the constant monitoring of the experimentation by the teachers who tested the material in real contexts. One consequence is that the software has been amended several times in response to the comments and suggestions collected from the community of teachers involved in the experimentation. However, many other teachers not directly participating in the experimentation have used these gamed spontaneously or heard about them: the great number of downloads from the IPRASE website and links to IPRASE from school websites all over Italy underlines a remarkable interest in this research and experimentation, which has been awarded a certificate of quality by INDIRE-ANSAS (the Italian national agency for the development of scholastic autonomy).

About the games designed

"Learning by playing" developed a large collection of educational software: various game genres were provided in this collection, from arcade-style to simulations created by the research team. Each game has been designed to focus on a very specific and precise topic (the four operations in maths, trigonometric tables, etc.). A CD-ROM provided software for pupils aged 6-14 (primary and secondary school), for subject learning. 101 Italian, Maths, Geography, Music and Science activities have been made available. On the IPRASE website some on-line science simulations were also available.

All the software was free for educational purposes, based on a computer platform and written in Flash or HTML programming language. In this way:

- any user can install and use them very easily;
- the games can run on all computer platforms;
- the games can be adapted (different levels, languages, content) to pupils' needs;

- the games are available at all times and easy to download from www.iprase.tn.it/prodotti/software_didattico/giochi/download/iprase_2006.zip : the .iso file of the CD-ROM is available for free download and burning.

A significant number of games run directly on the website, so everybody has a chance to try out the software before downloading it.

All the materials (CD-ROMs etc.) have been prepared and diffused by IPRASE in synergy with private partners, who provided support and financing. No central education authority support was needed or given, since school autonomy makes experiments like this possible in Italy.

About the use of games in the classroom

Teachers and pupils participating in the experiment had to follow a common protocol of experimentation which first needed to identify two groups of pupils in their schools: a user group (who really used games in learning activities) and a non-user group (also called “control group). Using grids, a diary and other material provided by the research group (such as final tests), teachers collected information related to the teaching/learning processes activated, the performance of the learners, the strengths and weaknesses of the software. Attention was focused on the use of technologies as a powerful instrument really able to support learning activities and improve learners’ performance.

Video games have been used especially in two ways: as a learning support (they worked as additional resources, as suggested by the research group at the beginning of the experimentation) or as the main vehicle of learning in teaching activities. It is important to note that some teachers (between 40 and 47% of them) used games in this second way, as powerful instruments to teach content directly. The fact that games could be used, if preferred, as a tool complementing more traditional ones has been an important factor in the success of the project in terms of teachers’ participation - this way of proceeding did not create big challenges for them.

Teachers involved in this project investigated and implemented various ways to use games with pupils, by considering, first, pupils’ learning profiles and the capabilities and potentials of each individual game; some teachers gave pupils the opportunity of free access to games, others planned prepared “learning paths” to be followed by their pupils. So teachers were free to organize their own learning environment, according to their different needs and circumstances. The IPRASE research group underlined only the necessity of regular and significant access to the games, broadly suggesting two kinds of frequency in using games: once in a week (for two months) or twice a week (for about 3 weeks).

Pupils played games in small groups (in pairs, especially in primary schools in a sort of “peer tutoring”, a useful way especially to solve technical or content-related problems) or individually (especially in secondary schools). In some schools, lack of computers sometimes constrained teachers’ choices in choosing between these two ways. Pupils used computer labs in their schools as a place to play. Some data, collected from interviews or in other ways, revealed that almost 30% of players used games not only at school but also at homes, because, on the one hand, the games were always available on the IPRASE website for free download and on the other hand, through a specific project (in the school year 2003/2004) parents were able to obtain a CD-ROM for their children just by filling in an on-line form.

The strategy for using games in the classroom

“Learning by playing”, as already underlined, explored the contribution of games to innovation and enhancement of quality as powerful learning instruments, by highlighting their potentialities in curricular activities.

Teachers who participated in the project have played an essential part in it, providing feedback on materials tested both in terms of the best conditions for use and efficiency, as well as suggesting ideas for possible new material and activities. Also very important was the fact that they were been able to be in contact with a large number of teachers having different professional backgrounds, approaches and preferences, thus extending their scope for collaboration. Pupils have also been part of the process, having the opportunity to make comments on the material and formulate new ideas, through questionnaires. In this way, teachers and pupils have been considered not only as end users but also as protagonists in the design and realisation of games and related activities.

It is important to note that not all the teachers, at the end of this action-research project, showed a clear and full understanding of the potential of video games in learning improvement: in short, they did not find any learning improvement, in their opinion. But, despite this, they declared that video games can be useful for:

- consolidating and exercises (47/103 answers)
- increasing motivation (33/103 answers)
- implementing a different approach to disciplines (8/103 answers)

(From “Imparo giocando: videogiochi e apprendimento - rapporto di ricerca sul quadriennio di sperimentazione”, a cura di R. Nesler, agosto 2007, IPRASE del Trentino, pagina 121)

The majority of the video games available in “Learning by playing”, made **in** and **for** schools, target primary and secondary pupils, without distinction, as specific software for remedial learning, for example, has not been considered in the experiment. IPRASE provided instead PC-based games for non-Italian pupils (and adults too) who need to learn the Italian language.

The strategic role of teachers involved in this project, especially as sources of feedback and suggestions, has allowed the spreading of “Learning by playing” through a sort of “jungle beat” all over Italy. In fact, every Italian teacher can easily use these materials because:

- a balance is struck between the amount of preliminary work and the benefits obtained. The proposal does not scare teachers or create too easy expectations;
- teachers encounter no problems with technology: each game matches their technological expertise and is easy to install and play;

- the material addresses didactic issues which traditional instruments could not effectively solve: for example, sometimes it is very difficult to individualize teaching and learning activities. These games can be helpful in doing this and Italian teachers are very interested to this aspect;
- the research activity provided a set of integrated materials: a curricular project pedagogically based on reflections about using ICT with pupils, didactic games, simulations, handbooks, a diary (to collect feedback, reflections on games and the learning process activated in pupils), exercises, a teacher's guide (to get to know and play each game) and a set of tests/questionnaires (for teachers and pupils, to collect qualitative and quantitative information). In short, this set of material gives some guidelines for a meaningful use of ICT with pupils, such as learning of different subjects through video games and simulations and stimulating examples of practical activities and tasks;
- to meet pupils' expectations (they always look for new different graphic settings and particularly engaging interactivity), the research group planned and created a large group of games targeting the same abilities and knowledge, in order to deeply engage pupils, especially in repetitive tasks (for example learning multiplication tables).

The research group, during the action-research activities and in the final report, often underlined the importance of a significant frequency in using games at school, to obtain an effective learning improvement, as well as the fact that pupils need time to gain a good knowledge of the games themselves. A discontinuous use of games is liable to be ineffective.

Finally, a community of practice, on-line in the school year 2005/2006, including teachers and experts, played a strategic role in creating and sharing an innovative curricular proposal focused on the use of ICT in schools with some pathways already activated.

Results and impact

At the end of the experimentation, the same final test was given out to pupils in both user and control groups. The main aim of these testing activities was to highlight any possible difference between the two groups in terms of learning outcomes (quantitative aspects in Maths and Italian). Specific questionnaires (for pupils and teachers) investigated qualitative aspects of the experiment, such as feelings or any other useful feedback.

The results showed that pupils who used games achieved better performances than others who did not used them, as follows:

Mathematics Test Results - 7 to 8 year olds

The difference between the two groups (1.96) is highly statistically significant (p<.001)

Mathematics Test Results - 9 to 10 year olds

Trial group	Control group
2248 students **Test result average 50.46**	773 students **Test result average 48.65**

The difference between the two groups (1.81) is highly statistically significant (p<.001).

Italian Language Test Results – 7 to 8 year olds

Trial group	Control group
1120 students **Test result average 51.72**	1281 students **Test result average 48.50**

The difference between the two groups (3.22) is highly statistically significant (p<.001)

Italian Language Test Results – 9 to 10 year olds

Trial group	Control group
1578 students **Test result average 51.68**	1443 students **Test result average 48.16**

The difference between the two groups (3.52) is highly statistically significant (p<.001)

Besides these quantitative results, a high percentage of teachers from Trentino (76.3%) noticed a significant improvement in pupils' learning and the same (but with a higher percentage, 86.6%) was observed by teachers from the other Italian regions (qualitative results according to teachers' perception - data from "Imparo giocando: videogiochi e apprendimento - rapporto di ricerca sul quadriennio di sperimentazione", a cura di R. Nesler, agosto 2007, IPRASE del Trentino, pag. 120)

Many teachers also noticed a difference in motivation between the groups, definitely higher in users than in control groups. Games are so interactive and engaging that they seem to activate motivation automatically, in a sort of "natural" way.

At present, according to information recently collected, all the schools in the Province of Trento (the province which started the experimentation) are using PC-based games in learning activities going beyond the experimental phase.

Some further comments

"Learning by playing" presents an innovative curricular proposal focused on the use of ICT in schools and first identifies the pedagogical and didactic principles on which the project is based. It also provides useful suggestions and activities for a learning pathway ("learning by playing"), centred on computer games and simulations, to teach pupils different curricular subjects. The main value lies in the combination of these three dimensions: pedagogical, didactic and technological. It is the first time that teachers in Italy have reflected on the pedagogical aspects of introducing ICT into schools and, especially, using games for learning. Games (and video games considered as their latest evolutionary form) are perhaps the most ancient vehicle for education, a kind of natural educational technology.

The pedagogical reasons for playing are the following:

- playing is a natural activity bound up with the biological evolution of human beings;
- playing is always also learning;
- games are a sort of disguise which evolution has given to learning;
- learning through games is a continuous succession of perception and reality, of reworking the data perceived and the responses given by the player in order to change reality;
- this kind of mechanism enables us to improve our performances and to understand the world with fun;
- play is the most common learning model in all children's pre-school activities;
- the symbolic-repronstructive learning model (which uses above all written texts) requires various abilities and skills, especially at an early age, which children often don't have."

(from "Imparo giocando: videogiochi e apprendimento - rapporto di ricerca sul quadriennio di sperimentazione", a cura di R. Nesler, agosto 2007, IPRASE del Trentino, pag. 94)

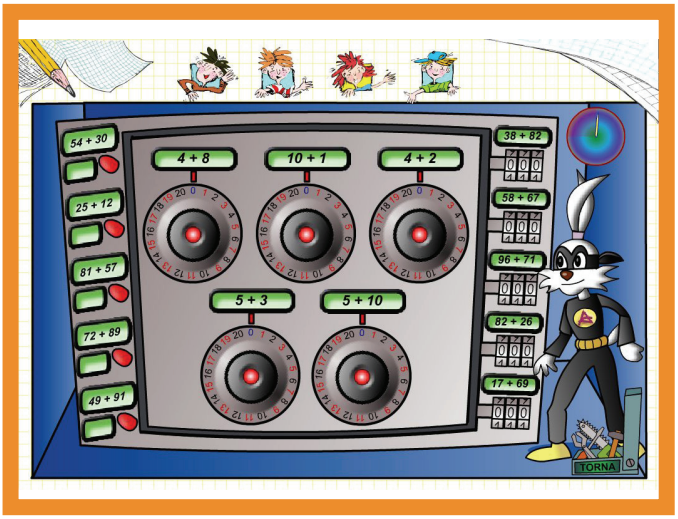
Besides this, "games are:

- entertaining and do not need to be imposed, because playing is a natural activity, especially for children;
- they have fewer requirements compared with symbolic-reconstructive learning;
- the assessment is not a 'separate' activity because it is included in the nature of the game, which always rewards positive results and discourages negative ones;

- the individualisation of learning becomes a simple problem to solve because interactivity mechanisms allow players to set the levels of difficulty according to their ability and knowledge."

(from "Didattica Assistita dalle Nuove Tecnologie", a cura di R. Nesler, novembre 2004, IPRASE del Trentino, pag. 28)

In fact, a typical learning problem in daily classroom activities is the different ability level reached by different students in the same class. In most IPRASE games, teachers and pupils can change a series of variables and can gradually increase or decrease the level of difficulty. Traditional instruments such as worksheets and exercises on paper cannot meet individual pupils<# needs and skills and, above all, are not so interactive and engaging.



Games (and video games, considered as their latest evolutionary form) develop a kind of motor and sensory learning, closer to pupil's characteristics than the symbolic-reconstructive one. This way of learning is related to handling, action and the analysis of the results obtained. The reasons for the greater emphasis put in schools on perceptive-motor learning through games and simulations are founded on a strong pedagogical ground: the "experiential" method.

The diffusion of IPRASE "Learning by playing" software in Italy has expanded exponentially in these years: a simply internet search (using Google or other search engines) shows quantitatively and qualitatively interesting results: very many schools, training institutions and teacher trainers know (and use) these games.

However, the data collected with questionnaires and in the on-line community of practice reveals some obstacles to using PC-based games in schools: lack of computers appears to be the most relevant difficulty for teachers as well a lack of flexibility in managing pupils in a different way from the traditional "scholastic/institutional" class.

Further information:

All materials and software

http://www.iprase.tn.it/prodotti/software_didattico/giochi/index.asp

Demos (not available for all the videogames)

http://www.iprase.tn.it/prodotti/software_didattico/giochi/presenta.html

On-line simulations (Science)

http://www.iprase.tn.it/old/biologia/filmati/simulazioni/sim_01.html

On-line labs (Science: Physics, etc.)

http://www.iprase.tn.it/prodotti/software_didattico/laboratori/index.asp

The Games Atelier, The Netherlands
A location-based mobile game platform

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Waag Society and its Creative Learning Lab

Waag Society is a non-profit organization which was founded in 1994 and since then has developed into an interdisciplinary think-tank on creative technology for social innovation. In 2001, the Dutch Ministry of Education, Culture and Science made the Waag Society the Centre of Expertise for Cultural Education and ICT. Waag Society's mission is to conduct research, invest in development, carry out pilot projects and make prototypes using creative technology for social and cultural innovation. It also provides advice on innovation projects to small and medium-sized enterprises (SMEs) and is the initiator of PICNIC,[15] the annual cross-media week in Amsterdam. It acts as an intermediary between the arts, education, science and the media, and cooperates with cultural, public and private organizations. Waag Society divides its main activities into four social domains: Healthcare, Culture, Society, and Education.

The Creative Learning Lab is Waag Society's department which develops creative technology for education. It supports and stimulates the integration of creative digital technology into school lessons by providing students with tools that facilitate active learning, based on collaborative and playful experiences. The Creative Learning Lab carries out applied research into the possibilities that creative technology offers for young people, and works closely with the educational and cultural sectors in developing pilot programmes and prototypes. Since April 2008, the Creative Learning Lab has offered a complete training programme, developed for teachers and school management of primary and secondary education in the Netherlands. In addition to the training available for teachers, the Creative Learning Lab also provides workshops for students to foster the creative and cooperative use of technology. The individual interests and capacities of students are taken as the focal point. The Lab's approach is to understand students as active media producers, and not merely passive consumers. The Lab uses its training programme, workshops, website, publications and seminars such as PICNIC Young[16] to promote the great potential of contemporary digital education.

Through its Education and Creative Sector Platform, Creative Learning Lab, in partnership with Kennisnet,[17] ICT Office[18] and the Group of Educational Publishers,[19] brings the education, creative and cultural sectors and the educational market together, in order to promote cooperation, increase and scale-up successful initiatives, and encourage the use of creative technologies to enrich the Dutch innovation climate. The Platform's aims are to enhance knowledge sharing and advancement, reinforce existing and develop new links between primary and secondary education, the creative sector and commercial companies, including publishers and content providers. Best practice cases from the creative sector are analysed and the implications of scaling them up explored. The Platform is facilitated by an online forum and mailing list.

Frequency 1550

Although there is now a substantial amount of literature on the design and effects of games-based learning,[20] mobile game-based learning in particular still remains under-researched. In 2005, with the conviction that educational mobile games provide an excellent way of combining situated, active and constructive learning with fun, Waag Society, in close collaboration with the Montessori Comprehensive School Amsterdam, the telecom company KPN Mobile and the Amsterdam Municipal Archives, developed the location-based game *Frequency 1550*, situated in Amsterdam. The game offers a compelling reconstruction of micro-aspects of everyday life in the medieval city of Amsterdam.[21].The game's manual tells the player 'You are a member of a pilgrim order that comes to town to see the Host of the Miracle and to found its own monastery in Amsterdam. But first of all, you have to win the right to build a monastery by becoming a burgher (citizen).' In order to become a full citizen a team needs to demonstrate its knowledge of medieval Amsterdam by completing media assignments and answering specific questions on the city's history. *Frequency 1550* was developed to complement a specific content area of the history curriculum for Dutch 12-14 year-olds, namely 'The age of cities and states: 1000-1500'.[22] There were two teams, each of four students. Two students from each team were based at the headquarters at The Waag in Amsterdam, and the other two students were on the streets of the city. Students learned about medieval Amsterdam in a realistic, meaningful context by walking through the city and observing medieval monuments and sites. Their task was to answer questions and complete assignments on location using their GPS-enabled mobile phones, guided by their fellow team members who were following their progress online on the laptops at the Headquarters. The results of the completed assignments and team collaboration were recorded on a team website displaying all their media and scores.

The two team members on the streets of Amsterdam were equipped with a game phone linked to a Global Positioning System (GPS) receiver, and a video phone. All game phones had an internet connection and were permanently connected to the game server at Waag Society. The two team members at the Headquarters also had a video phone and a laptop with an internet connection. With the help of a GPS receiver, the game phone displayed the position of its team on a medieval map of Amsterdam. Using their video phone and game phone a team could make video calls to their Headquarters, receive and watch pre-recorded video messages featuring medieval characters, and complete and send assignments (video clips and pictures) to the Headquarters. Using their laptops, team members at the Headquarters had a game application with internet access in order to look up information, research historical references and send relevant information to the players in the city to help them complete their assignments. The Headquarters team were able to see each player walk through the city in real time, as coloured dots on the medieval map as well as on a current map of Amsterdam. They used this tracking system to figure out the team's strategy and used their phones to guide their city team players towards the locations where the assignments were hidden. The assignments were centred around six themes: labour, trade, religion, rules and government, knowledge, and defence.

Method

In this first 2005 pilot of *Frequency 1550* the game was played by one secondary school class in Amsterdam. Students played in six teams of four or five for two days in periods of three hours. Before each period of gameplay, the students were briefed regarding the game's instructions. On the third day, after two days of playing, all teams met at the Headquarters for a collective debriefing on the media they had produced, the answers they had provided and the strategic decisions they had taken during the game. Students also took a test on their historical knowledge of Amsterdam. The questions in the test were based on the game's narrative as well as factual historical knowledge. Each team had a guide who observed the city team's activities and evaluated these afterwards. The evaluation data collected during this pilot therefore included the students' answers to the tests, their reflections during the debriefing session at the end, and the products made during the game. The results were very positive. Students reported that they thought playing the game had improved their technological skills and found it much more enjoyable than traditional history lessons. An important finding from this initial pilot was that the use of smart phones, GPS technology and the internet, and particularly the creation and communication of picture and video images, sound and an online presentation, had a positive impact on students' digital media literacy.[23] However, it was found that the game took too long to play, and no concrete conclusions were reached regarding the impact the game had on learning outcomes.

Given the positive results of this first pilot, it was decided to invest in a further larger scale pilot project of *Frequency 1550*. This second pilot was tested, implemented and evaluated during the last week of May and first two weeks of June 2007. Although the game itself was redesigned by Waag Society, the lesson series, including the texts and assignments which accompanied the game, were designed in close cooperation with five History teachers from the schools participating in the pilot. An improved version of the game based on the findings from the first pilot was used. The game was re-designed to last only one day, as opposed to two days. This time the main objective of the pilot was to assess the impact that playing *Frequency 1550* had on students' learning outcomes. The cognitive and affective effects of the game compared with traditional lessons were compared. The experimental group consisted of ten classes playing *Frequency 1550*, while the control group consisted of ten classes receiving traditional lessons on the medieval history of Amsterdam. Altogether 458 students aged between 12 and 16 (most of them 12 or 13) took part. The were from Montessori Comprehensive School Amsterdam and the Open School Community Bijlmer, two secondary schools in Amsterdam. A mixture of quantitative data (comprising test scores and students' sex, age and ethnicity) and qualitative data (comprising comments and interviews from the observation and evaluation sessions, students' essays, products, logbooks, and track and tracing from the game) were collected. The quantitative data was analysed by performing multivariate regression analyses with the intervention as an independent variable, motivation, knowledge and attitude towards collaborative learning as dependent variables, and students' age, sex, ethnicity and ability as covariates.

Results

Engagement and motivation

Students were in general very enthusiastic about the game, whether playing in the city or at the Headquarters. Most pupils were able to keep on-task and successfully complete their assignments. However, due to technical problems, students in the city sometimes lost focus as they were unable to do anything while the technical problems were occurring. It was found through some of the evaluation activities that students actually preferred being at the Headquarters rather than in the city, which was contrary to what was initially expected. It transpired from the observations and evaluations that this was because students at the Headquarters were more in control of the game and had a better overview, as well as being less likely to become demotivated, because they had alternative activities, such as searching the internet, while waiting for technical problems to be resolved. No significant difference was found between the control and experiment groups in terms of motivation for learning History, and particularly the subject of the Middle Ages. A possible reason for this could be that playing the game for just one day is not enough for it to have any significant motivational impact. Also, some of the evaluation results indicated that some of the game's assignments may have been too difficult or at least too time-consuming for the 12-14 age-group. Finally, the technical problems that arose also explain in part the lack of a significant increase in motivation.

Historical knowledge

All students from both the experimental and the control group took a knowledge test about medieval Amsterdam. The condition of playing the game proved to have a significant effect on the knowledge test score, when testing for impact by controlling relevant variables. Students who played the game generally gained higher scores than those who attended traditional history lessons. The impact of playing the game was deemed strong, as almost 28 percent of the variance in scores was explained by the intervention. It is likely that students who played the game remembered more of the information they received because it was presented in a realistic and meaningful context, and because they themselves actively took part in analysing the content. From these results it would seem that *Frequency 1550* argues in favour of the possibility of successfully combining instructivist and constructivist approaches to learning. Students are instructed how to play the game while at the same time having to construct the knowledge required to play and win the game. Researchers from the University of Utrecht found the game's narrative rich in learning potential, since in history education the use of narrative is helpful in relating historical characters and events to meaningful connections of temporality and sequence, also known as 'storification'.[24]

Collaborative skills

Both teachers and guides reported that as a result of the game students successfully learned how to navigate their way through the city and collaborate at a distance with their team members. The collaboration consisted in communicating with their close and distant team members as well as working together on joint team assignments. The playing of the game and the discussion between students about game tactics ensured the development of their communication and collaboration skills.

In summary

The two pilots of the mobile game *Frequency 1550* illustrated that the game supports Gee's theory on games-based learning, as it allows for the 'empowerment of learners'.[25] The pilots demonstrated that playing the game had a cognitive effect on students in terms of increasing their retention of historical knowledge compared to students following traditional history lessons. However, playing the game did not prove to have any affective impact on students, as their motivation for learning history and more particularly the subject of the Middle Ages was not significantly different from those in the control group. Although the research study on the pilot projects concluded that playing *Frequency 1550* contributed to students remembering facts about medieval Amsterdam, it is still unclear what precise elements of the game actually caused this positive effect

on students' learning.[26] Further research is needed to find this out. The researchers from the Universities of Amsterdam and Utrecht also concluded that they expected the game to have further learning potential in terms of knowledge transfer and motivation if students were allowed to actively create the games themselves. As a result of the success and interest in developing this mobile game, Waag Society decided to embark on the *Games Atelier* project, which builds on the knowledge and experience gained from the two pilots of *Frequency 1550*.

The Games Atelier

"Maatschappelijke Sectoren & ICT" (Society Sectors and ICT) is an action programme of the Dutch Ministry of Economics, which launched a call for proposals to fund ICT-related projects starting at the end of 2006. 23 projects were funded from the education sector, and 7 of these were focused on electronic games.[27] The criteria for receiving this state funding were to present a project that had already been piloted, had produced good results and had potential for further development. This, as shown above, was indeed the case with the *Frequency 1550* project, which won international recognition by winning the Comenius Edumedia Award[28] in 2006, and went on to win the Dutch silver SPIN Award[29] in 2007. Waag Society therefore won public funding to develop this game into the *Games Atelier* project, which started at the end of 2006 and will terminate in July 2009. The development of *the Games Atelier* has been based on the technology and the evaluation of *Frequency 1550.*

The *Games Atelier* is a new location-based mobile game platform developed by Waag Society, in collaboration with five local secondary schools in Amsterdam and the Amsterdam City Department for Social Development, allowing students to make and play their own games in an authentic context. *Games Atelier* uniquely combines the virtual domain of the computer with the physical and social aspects of the real world. It uses a learner-centred approach, and encourages self-motivation, as students create their own game according to their personal context and environment. It is supported by a mobile and web-based tool-set and technology platform tailored to location-based projects called *7Scenes*.[30] The *7Scenes* software used for The *Games Atelier* gives students a location-based authoring environment which they can use to create their own mobile games. Based on different game templates (described below), students can add photos, videos, sound, notes and tasks to specific locations on a map and create narratives around them. The students can then subsequently publish their games online, set up teams and create a competition. Using a mobile application and GPS, players navigate the city, follow the narrative, collaborate with other team players, carry out assignments and record and upload media to score points. Their game is then broadcast live on the web and archived so that they can play back the entire gameplay and reflect on the different processes that took place, including the routes they took, the sites they encountered and the media they created.[31]

In order to make their own game with *Games Atelier*, students can choose between three game templates: *Secret Trail*, *Collect and Trade*, and *Adventure*. Each game template has its own set of rules and levels of difficulty, with *Secret Trail* being the least difficult, *Collect and Trade* of average difficulty and *Adventure* the most difficult. Waag Society's Creative Learning Lab describes the different game templates in the following way:[32]

Secret Trail*

Secret Trail is a scavenger hunt along different places in the city. Hints and assignments that appear on a mobile telephone allow players to gather points as they solve a puzzle along the way.

Collect & Trade**

In this game, players must collect a specific combination of objects. The teams may have different assignments. Objects are hidden at certain locations and can either be found or must be earned. In order to have the correct combination of objects, the players can trade with one another on the street.

Adventure***

Players come together in a game narrative in which they each play a specific role as a character. Each character has a unique skill that determines his/her power and opportunities. Various assignments are placed at different locations for the different characters. Certain skills gained during the game are necessary to complete the assignments. These skills also increase the power and opportunities of the characters. During the game, the different characters are forced into confrontation if they are near one another, with the opportunity of winning or losing points.

Within each template students are asked to choose and design the subject, team play, game board and game board elements, including the aim of the game, game rules, assignments, roles, story line, setting, locations, and the end goal.

A four step learning process

The *Games Atelier* gives students the opportunity to use mobile telephones, GPS and internet in order to *make*, *play*, *share* and *review* their own games. In order to make the game, students have to think of an initial concept and game narrative, before developing rules and filling in the format of the game. In this first creative phase of making the game, in order to come up with a relevant game narrative, students must fully familiarize themselves with the learning content of the subject. At the same time, in order to be able to develop rules and fill in the game format, they also have to learn about the principles of game design. The next stage is for the students to play the game in their own living environment. Playing the game involves using mobile phones and GPS to navigate their way around their surroundings to carry out assignments and search for clues. Sharing the game means getting other students to play the game they have made, and then to exchange their experiences of the game on this basis. Finally, the last and crucial stage of the *Games Atelier* learning process is reviewing the games played. Each game-round can be re-watched after completion, thus facilitating reflection on the way the game was made and played. The students can use this reviewing phase to learn from one another and to understand how they might improve certain aspects of their own game. The teacher also plays a vital role in this final reflection stage, as he/she has the opportunity to focus on difficult aspects experienced during the previous stages, and to jointly discuss with the students how these might be tackled in a successful way. All four steps, including making, playing, sharing and reviewing the game, involve the structural and intrinsically motivational aspects of successful electronic games, as identified in the prolific academic literature in this area. These aspects include: rules, gameplay, narrative, one clear final goal and subtasks that contribute to reaching it, challenging and pleasantly frustrating problems, levels, instant feedback, speed, competition, and a non-linear structure.[33]

Flexibility

The *Games Atelier* has been developed in collaboration with teachers and students for teachers and students, and has specifically been designed to be used as a tool to enhance the teaching of the existing Dutch national curriculum. It allows for maximum flexibility in terms of how it is used as a learning resource in the school context. First, it can be used in any location to enhance the teaching of any subject. It can also be used with small or large groups, during lessons or as a wider school activity. Teachers have the option of making the games themselves to complement the teaching of particular topics and skills, or they can choose to use a number of available sample games. Alternatively – and preferably - teachers can get the students to make the games themselves, thereby offering them further learning possibilities. In order to suit different school timetable constraints, *Games Atelier* has been designed so that it can be used in small, medium or large sessions. A simple game can be built in a two-hour lesson, and can be then played during the next lesson. Larger, more complex games can be developed over a series of lessons, or as part of a longer-term project where students are involved in researching a subject in depth.

Collaborative learning

The *Games Atelier* was developed with a specific purpose: to increase social involvement among young people by involving the physical environment in education and allowing students to both create and play location-based games. It was built around a collaborative concept whereby students relate to one another and their surroundings, jointly create a game through constructivist learning, share their game with the wider community by publishing it online, and finally reflect together on the whole process. Collaborative learning is therefore at the heart of every step of the *Games Atelier* process. The gameplay stimulates students to negotiate and interact with one another. While playing the game students use mobile devices which facilitate collaborative learning from a distance by means of voice calls, video conferencing and text messages. The problem-based approach on which the game is built requires students to collaborate with one another in order to be successful.

Testing the Games Atelier and its future

The *Games Atelier* was tested during 2007 and 2008, and on 14 March 2008, the Mayor of Amsterdam, Job Cohen, launched the citizenship pilot of the *Games Atelier* which caused much general excitement and received a lot of media attention. This pilot involved 20 students between the ages of 12 and 18, who participated in the process of making and playing citizenship games on themes such as cultural diversity, social behaviour, and urban creativity. Through the games students collaboratively explored how people are connected and relate to their city and its residents. Each location-based game that was produced was different and reflected the diverse personal experiences and perspectives students had in relation to citizenship. The *Games Atelier* has been internationally recognized with the Erasmus Euromedia Seal of Approval from the European Society for Education and Communication (ESEC).[34]

As a result of the positive findings and thorough investigations into the learning benefits of *Games Atelier* and its predecessor *Frequency 1550*, it has been decided that in 2009 the *Games Atelier* will be implemented as a validated learning tool for secondary schools in the Netherlands. To kick-start this process of up-scaling the use of *Games Atelier* to national level, a national contest called the Mobile Game Quest was launched in November 2008 and will run until the end of March 2009. This contest is open to all secondary schools and gives them the opportunity to form a group and create their own game using the *Games Atelier* platform. A jury will then choose the best three games. So far the contest seems to have generated quite a lot of interest, with 55 groups having already registered from 12 schools across the country. This national contest acts as a free trial for all schools interested in using *Games Atelier* in the future. From 1 April 2009, *Games Atelier* will be available for all schools to buy from the national online software distributor for secondary education.[35] Buying the *Games Atelier* licence package also includes free training for teachers from Waag Society staff, both on the school premises and at the Waag Society. Initially it will be up to schools to use their own budget to invest in buying the *Games Atelier* licence. However, in the future, overarching public bodies such as the Ministry of Education, Culture and Science or national cultural organizations may choose to purchase the licence to make it widely available to all schools. It has been decided that the Universities of Amsterdam and Utrecht will again undertake academic research on the learning effects of *Games Atelier* (as they did for *Frequency 1550*), but this time focus on the impact of creating as well as playing the location-based game. The research will be part of a larger 4-year research programme on location-based playful learning in secondary education, particularly targeting the impact on usability, learning and engagement. A pilot project to develop *Games Atelier* for primary schools is also currently underway. Licences for vocational and higher education will also be available from 1 April 2009. It is hoped that the use of *Games Atelier* across the country will make the Dutch learning environment a playground, where learning and fun go hand in hand.

Further information:

Frequency 1550

http://www.waag.nl/project/frequentie

The Games Atelier

http://www.waag.nl/project/gamesatelier

Zoo Tycoon 2, Austria

The use of a commercial simulation computer game, at BG/BRG Zell am See school in Pinzagau, Salzburg

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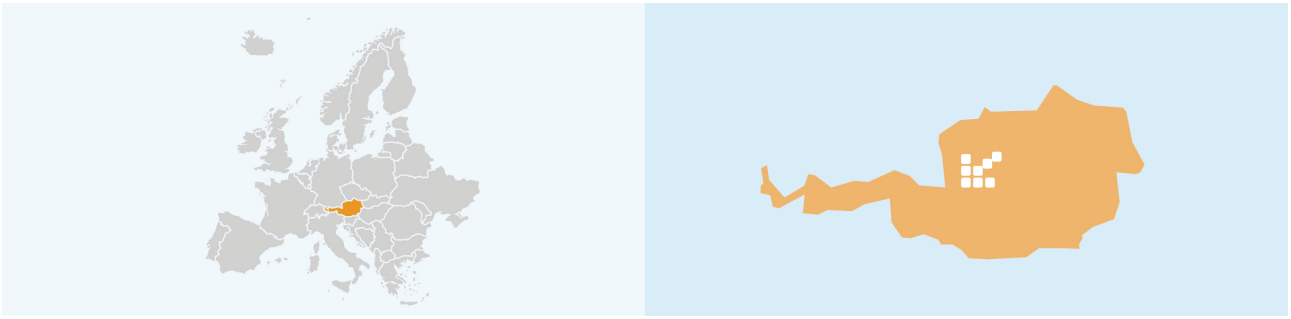


Description of project

In 2008, the Austrian Federal Ministry for Education, Arts and Culture (BMUKK) invited secondary and vocational schools all over Austria to participate in the project 'Educational Scenarios for Digital Game-Based Learning' (Didaktische Szenarien des Digital Game Based Learning). The Ministry financed this pilot project, which was supervised by the Danube University Krems and the University of Vienna, to test the possibilities of using commercial computer games in the classroom. The aim of the project was to explore the potential of digital game-based learning in the everyday school context and to investigate the direct connection between the school and media environments of young people. During the project the following factors were taken into consideration: the time constraints of teachers and pupils, the agreement of parents, the schools' technical equipment, and the resources available for purchasing computer games licences.

This case study describes how one of the first Austrian schools to participate in the project, BG/BRG Zell am See school, became involved by using the computer game *Zoo Tycoon 2* in the classroom. The school's Head Teacher, Mag. Rainer Hochold, decided that because computer games play an increasingly important role in many areas of society, it would be a good idea to get his pupils involved in this project. Parents were informed about the project and their children's use of computer games in the classroom. 25 pupils mostly aged 12 from class 2b of BG/BRG Zell am See school participated. The two teachers initially involved in the project had the opportunity to attend a workshop to learn how to play and use the game at Danube University Krems, before they experimented using it in their classroom with their pupils in April 2008.

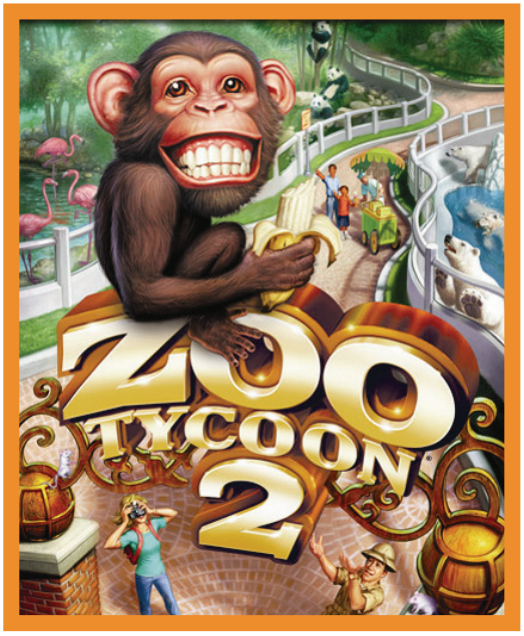
BG/BRG Zell am See school

BG/BRG Zell am See school is an advanced secondary school providing general education for 11-18 year-olds, situated in the heart of the countryside in Pinzgau, Salzburg, Austria. It is one of the most innovative schools in Austria and cooperates with numerous other educational institutions to offer its pupils additional courses and activities of interest. The school is recognized for its excellence in IT, evidenced by the various titles and responsibilities it holds in this area, including:

- The Educational Centre for Information Technologies (zellBIT), in cooperation with Zell am See commercial college and school

- Microsoft Academy[36]
- e-Learning Cluster School (one of the 45 schools in this cluster, recognized as the most innovative Austrian schools by the Federal Ministry of Education, Science, and Culture)
- Autonomous Branch Office of the Pedagogical Institute Salzburg

The game: *Zoo Tycoon 2*



Zoo Tycoon 2 is a commercial simulation computer game created by Microsoft Games Studio. The game can be ordered online[37] and costs approximately 20 euros.

The game was provided to the class by the Ministry of Education, Arts and Culture. It enables pupils to create their own zoo and manage it, with all the tasks and responsibilities this entails: buying and looking after the animals, building proper enclosures, taking care of the infrastructure, offering entertainment for the visitors, and so on. The game offers multiple construction possibilities and challenging management tasks. It has various features and can be played in different modes.

These include:

Amazing Animals - You can get up close to your favourite animals and examine their peculiarities

Zoo Guest Mode - In this mode you can 'Stroll through your zoo in first-person, just like a guest'

Zoo Keeper Mode - In this mode you can look after the animals by feeding, watering and grooming them

Photo Safari Mode - Here you can take photos of your favourite animals and guests and share them with others online

Impressive Exhibits - This allows you to create exhibits using easy-to-use construction tools and hundreds of building objects to build moats, make waterfalls and install fences

Habitat Editor - The habitat editor tools allow you to create mountains and valleys to create sophisticated environments for the animals

Biome Brush - The Biome Brush allows you to quickly create lush landscaped environments with terrain and vegetation appropriate for the African Savannah for example, or any other biome selected

Buildings and Scenery - This allows you to create the infrastructure of the zoo, including food stands, toilets, park benches, animal statues, gift shops and decorative arches

Zoo Management - This feature of the game requires you to use effective management skills to reach your goals, which are to maximize animal welfare, customer satisfaction and zoo profits

Different Modes - The game can be played in 'free form', 'challenge' or 'campaign' mode

Zoopedia - The Zoopedia can be used to look up interesting facts about the animals in your zoo. For example, pupils can learn that camels can close their nostrils to keep out dirt and sand

How the game was used

The game was first used in German lessons by the German teacher, Mag. Heidelinde Eder-Kaserer. In these lessons the game was used as a stimulus to encourage the learning of language skills, either by using the game content to initiate debates on the issues raised (such as the rarity of certain animal species) or by acting as an inspiration for written assignments. After playing the game pupils were asked to use the content of the game and their experiences to fill in project diaries, write blog entries, interviews and letters. So playing the game was only one part of the lesson, which was then integrated into related learning activities. Once teachers and pupils were familiarized with the game and felt more confident, the original English edition of the game was also used in English lessons by Dr Peter Wittner. The English version of the game proved particularly useful for enlarging pupils' vocabulary and assisted in the acquisition of linguistic skills. While pupils played the English version of the game, the online translation program *Leo*[38] was open, so that new foreign words could be looked up immediately. In both lessons, through the game, pupils acquired knowledge about the animals they encountered, their habitats, needs and how to protect their environment. They also learned important skills, such as how to plan in advance as well as developing their economic competences.

Zoo Tycoon 2 in the Classroom
Source: http://www.donau-uni.ac.at/de/department/imb/bereich/appliedcomputergamestudies/id/12372/index.php

Pupils played the game in small teams of two or three in the school's computer lab rather than the ordinary classroom. *Zoo Tycoon 2* was specifically used with the intention of developing pupils' team work skills and so a lot of emphasis was put on the importance of pupils collaborating with one another during the game and also after it for reflection purposes and to produce follow-up work. The teachers involved in this project found that playing the game in small groups facilitated the learning of social and communication skills. The project was deemed to be so successful by the two German and English teachers who initially took part, that as a result Biology and Art teachers in the school also decided to integrate *Zoo Tycoon 2* into their lessons. In Biology lessons the game was used to teach about animals and their habitats, and in Art lessons pupils were asked to draw pictures of the animals they had encountered while playing the game. All teachers concluded that the commercial computer game Zoo Tycoon 2 could be successfully used to teach the existing curriculum in the classroom, and that it perfectly combined learning with fun.

Further information:

Information about the project ‘Educational scenarios for digital game based learning’ (Didaktische Szenarien des Digital Game Based Learning)

http://www.donau-uni.ac.at/de/department/bildwissenschaft/appliedgamestudies/10923/index.php

General information about the project

http://medienabc.wordpress.com/2008/05/09/computerspiele-im-unterricht-2/

Information about the game Zoo Tycoon 2

http://zootycoon.com/

Homepage of BG/BRG Zell am See school, Pinzgau, Salzburg, Austria

http://www.gymzell.at/php/english_info,10510.html

Endnotes

[1] ITMF, IT og Medier i Folkeskolen, 2001-2003 http://itmf.dk/
[2] Dragon Fist – Ben Olding Games: http://www.benoldinggames.co.uk/benoldinggames.asp?SiteID=11&PageID=339&SectionID=0
[3] Adventure Quest: http://www.battleon.com/
[4] Samorost 1: http://amanita-design.net/samorost-1/
[5] Samorost 2: http://amanita-design.net/samorost-2/
[6] Carsten Jessen, 'Læringsspil og leg' in Andreasen, L. B., Meyer, B. & Rattleff, P. (eds), Digitale medier og didaktisk design. Copenhagen: Danmarks Pædagogiske Universitetsforlag, 2008.
[7] JPCK, Junior PC-Kørekort: http://junior-pc-koerekort.dk
[8] Multimedieforeningen: http://www.muf.dk/
[9] Faststone Capture http://www.faststone.org/download.htm
[10] The Scottish Government is responsible in Scotland for all issues that are not explicitly reserved to the United Kingdom Parliament at Westminster by the Scotland Act; including National Health Service Scotland, education, justice, rural affairs, and transport. Learning and Teaching Scotland is a public body sponsored by the Schools Directorate, which is one of the Scottish Government's Education and Lifelong Learning Directorates.
[11] In the Nintendo group there were five teachers in Aberdeenshire and two teachers in each of the other three Local Authorities; Western Isles, Dundee and East Ayrshire. The same number of teachers were involved in the control group.
[12] The Tamagotchi is a handheld digital pet created in 1996 by Aki Maita and sold by Bandai. The Tamagotchi is housed in a small and simple egg-shaped computer. Three buttons (A, B, and C) allow the user to select and perform an activity, including feeding, cleaning and playing games with the Tamagotchi.
[13] Hairy Maclary is a fictitious Skye Terrier, the anti-hero of many books written for children. The character was created by the New Zealand author Lynley Dodd.
[14] Crufts is an annual international Championship conformation show for dogs organised and hosted by the Kennel Club (UK), currently held every March at the National Exhibition Centre (NEC) in Birmingham, England.
[15] 'PICNIC brings together and disseminates the ideas and knowledge of the world's best creators and innovators, through a top-class conference, a broad selection of seminars, a series of hands-on workshops and many other events…. PICNIC spotlights cutting-edge products and services at the intersection of media, technology, arts and entertainment, and brings together entrepreneurs, investors and creators as well as scientists, and other industry leaders.' See: www.picnicnetwork.org
[16] See: http://picnicyoung.nl
[17] 'Kennisnet is a public ICT support organization in the Netherlands. It aims at national and regional cooperation with schools, branch organizations and (municipal-) governments to provide tailor-made ICT support within a broad spectrum of educational target groups in primary, secondary and adult education. Kennisnet is demand-driven and continuously monitors specific needs in ICT and education.' See: http://corporate.kennisnet.nl/international
[18] The ICT Office is a branch organisation for companies in the IT, telecom, Internet and office sector in the Netherlands. The activities of the ICT Office consist of market stimulation and the defence of the interests and services of its over 500 members. See: http://www.ict-office.nl
[19] The Group of Educational Publishers (Groep Educatieve Uitgeverijen (GEU) is a branch organization of 41 members which supports publishers in making learning tools available to primary, secondary, vocational, adult and higher education. See: http://www.nuv.nl/web/GEU
[20] See the scientific literature review by M. & P. Pivec in this report
[21] Raessens, J. Playing History. Reflections on Mobile and Location-Based Learning. In: Hug, T. (ed.) Didactics of Microlearning. Concepts, Discourses, and Examples. Münster: Waxmann Verlag, pp. 141-160., pp. 155
[22] Raessens, J. Playing History. Reflections on Mobile and Location-Based Learning. In: Hug, T. (ed.) Didactics of Microlearning. Concepts, Discourses, and Examples. Münster: Waxmann Verlag, pp. 141-160, pp. 155
[23] Raessens, J. Playing History. Reflections on Mobile and Location-Based Learning. In: Hug, T. (ed.) Didactics of Microlearning. Concepts, Discourses, and Examples. Münster: Waxmann Verlag, pp. 141-160, pp. 150

[24] Akkerman, S., Admiraal, W., & Huizenga, J. (2008) Storification in History education: A mobile game in and about medieval Amsterdam, Computers & Education, (In press). Accessible at: www.ilo.uva.nl/homepages/wilfried/docs/CAE_2008_online.pdf
[25] Gee, J. P. (2005) Learning by Design: Good video games as learning machines, E-Learning, Vol. 2, No. 1, pp. 5-16
[26] Admiraal, W. Akkerman, S. Huizenga, J. tenDam, G.T.M., Cognitive and Affective Effects of Learning History by Playing a Mobile Game, Proceedings of the 2nd European conference on games-based learning, Universitat Oberta de Catalunya, Barcelona, Spain, 16-17 October 2008, pp. 211
[27] For a list of all the education projects funded under this call of proposals from the Ministry of Economics see: http://www.m-ict.nl/index.php?option=com_content&task=category&sectionid=27&id=55&Itemid=212
[28] See: http://www.comenius-award.net/
[29] See: www.spinawards.nl
[30] See: www.7scences.com
[31] Admiraal, W, R. Lenz. R. van Zeijts, H. Games Atelier. Location-Based Gaming: The City as Your Playground, Online Educa Book of Abstracts, pp. 211-215
[32] See: http://www.waag.nl/project/gamesatelier
[33] Veelo, K. (2007), Games Atelier: a learning environment for producing and playing location-based mobile games, Master thesis, pp. 135
[34] See www.esec-online.net
[35] See www.slbdiensten.nl
[36] See http://www.microsoft.com/uk/academia/software/msdnaa/default.mspx
[37] See http://www.amazon.de/Microsoft-Zoo-Tycoon-2/dp/B00009P51N
[38] See http://dict.leo.org/

How do teachers use games in schools?

5. How do teachers use games in schools?

Main findings

Whether or not they use electronic games in their teaching, the teachers surveyed express a real interest in their potential: 80% want to know more. Almost the same percentage of teachers already using games say they are interested in making greater use of them. 50% of the teachers who have not yet used them say they would be interested in trying them out.

Among the survey respondents, male and female teachers of all ages use electronic games in their lessons. How long they have been teaching is not a decisive factor, except among those who have been teaching for more than thirty years, very few of whom say they use electronic games in their lessons. Both primary and secondary teachers use these games. You don't have to be a games expert to use them in the classroom: 85% of the teachers who use them say they are have "moderate" games skills (57%) or even those of a "beginner" (28%).

The teachers questioned most often expect these games to motivate their pupils, while contributing to the educational goals in terms of content, skills (especially social skills) and values. Their "ideal" game can be used in a flexible way, contains valid content and information, is easy to use and understand, and didactically well structured.

More specifically, the teachers say, for example, that they use electronic games to increase pupils' autonomy in their learning, to personalize it, and in some cases to reward it.

Language lessons (both mother tongue and foreign languages) are the ones for which the teachers most often say they use electronic games. History, Geography and Maths are also often mentioned. In addition, games are more often used to develop teamwork and intellectual skills. Only 13% of the teachers surveyed use games to teach specific groups of pupils.

The obstacles that the teachers encounter in integrating games into the teaching process are varied, and their relative importance depends on the context. Difficulty in matching the game to the syllabus, lack of available computers, the organisation of teaching time, the attitude of the school and parents towards games, and the cost of games and licences are often cited. The lack of studies on the impact of games on the educational process is clearly regretted.

The teachers quite often say that they use entertainment games and commercial games in their lessons. More detailed research is needed in this area to measure more precisely how they are used in comparison to explicitly educational 'serious' games.

Teachers get the information and training they need to use electronic games in the classroom mainly from the internet and their colleagues.

The teachers in the survey expressed a positive view of games in terms of the motivation of students and the development of a wide range of skills. They are less persuaded of their impact on critical skills and performance in the specific subject taught.

Introduction

Purpose and context of the survey

The survey was designed to discover more about the use of electronic games by teachers in their pedagogical process: which types of games they use; what their expectations and objectives are; for which subjects, type of skills or categories of learners they use them.

Specific attention was devoted to identifying the various obstacles they encounter when using games in the classroom with pedagogical purposes. Within this view, both teachers using and also teachers not using games in schools were targeted.

The intention was also to collect feedback from teachers who did use games in schools, about the impact they consider the games have had on the pupils and all aspects of the learning process.

The launch of the survey

The questionnaire was made available online, in nine different language versions[1], between October 2008 and February 2009.

The survey was announced in newsletters and websites of European Schoolnet, ministries of education and/or agencies responsible for education at national or regional level or more precisely for the use of information and communication technologies applied to education. Teachers were invited to participate in the survey and directed to an internet address where the questionnaire was available to be filled in.

These newsletters and websites are not "games oriented" – on the contrary. They are run by official educational institutions and are of a much more general nature. The aim was in fact to reach teachers not necessarily already advocating the use of games at schools, but interested in ICT and having or not some experience with games.

Approach adopted for the data analysis

The following steps were undertaken in order to produce the analysis of the data collected:

The data consisted of coded responses to the different questions of the survey, presented in Excel sheets. After inspection and analysis of the data, a number of records were removed, because they were completely empty or because most of the key questions had not been answered. A few records, which either included the same answer to all the questions or contained absurd answers, were also removed. Ultimately, 528 were retained for further analysis.

In order to produce the final version of the analysis, frequency distribution of the answers to all closed questions in the survey has been calculated and the results presented under the form of tables and graphs.

In a number of cases, the relationship between the answers to different questions has been cross-analysed.

[1] English, French, German, Spanish, Italian, Danish, Dutch, Lithuanian, and Estonian.

Distribution and profile of the respondents

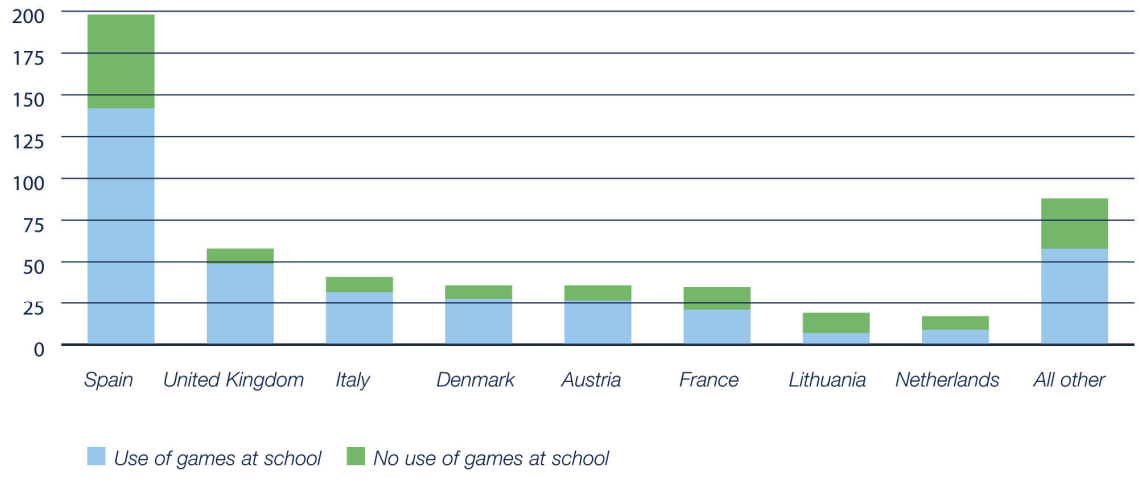
Distribution of the respondents by country

Responses to the questionnaire were received from teachers in 27 different European countries. The distribution of respondents by country is displayed in Table 1 and the following graph:

Table 1

Distribution of respondents by country and use of games at school			
	Use of games at school	**No use of games at school**	**Total**
Spain	142	56	**198**
United Kingdom	49	9	**58**
Italy	32	9	**41**
Denmark	28	8	**36**
Austria	27	9	**36**
France	21	14	**35**
Lithuania	7	12	**19**
Netherlands	9	8	**17**
All other	58	30	**88**
Total	**373**	**155**	**528**

Distribution of respondents by country and use of games at school

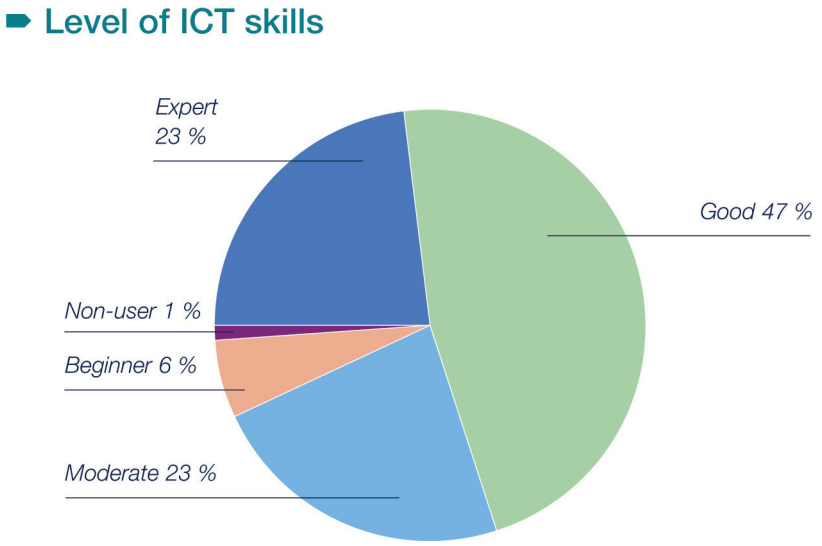


Overall, **528** usable responses were available at 25 February 2009, when the survey was closed. Of the 528 respondents, **373** (or 70.6%) said that they used games in school.

The eight countries presented in this table and the graph are those which were specifically targeted by the survey. It is interesting to note that 88 responses were received from teachers in other countries. This included 21 from Romania, 16 from Belgium and 12 from Portugal.

Level of ICT Skills

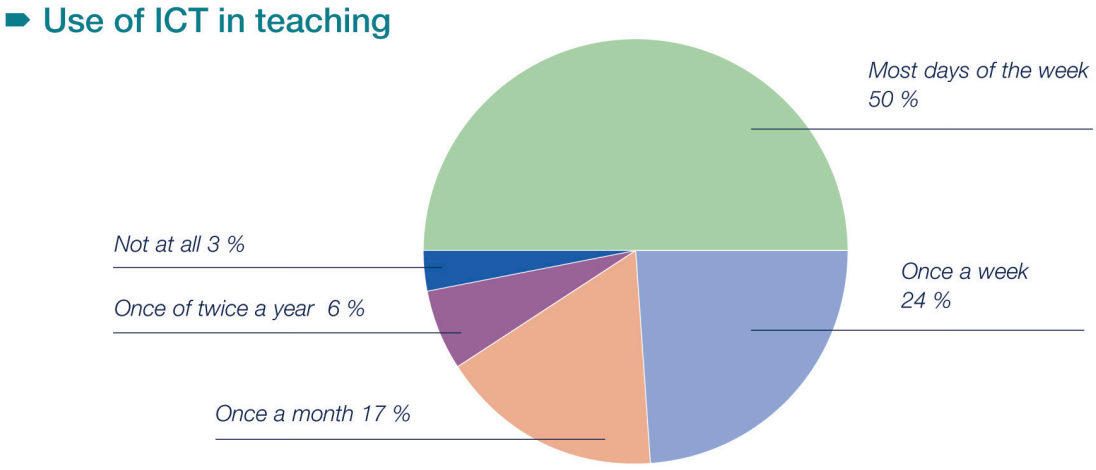
The respondents' level of ICT expertise is shown in the next graph (the question in the survey was: "How would you rate your ICT skills?"):



70% of the respondents rated themselves "good" or "moderate". About a quarter considered themselves to be an "expert" in ICT (over half of these were ICT or Technology teachers).

Frequency of ICT use in teaching

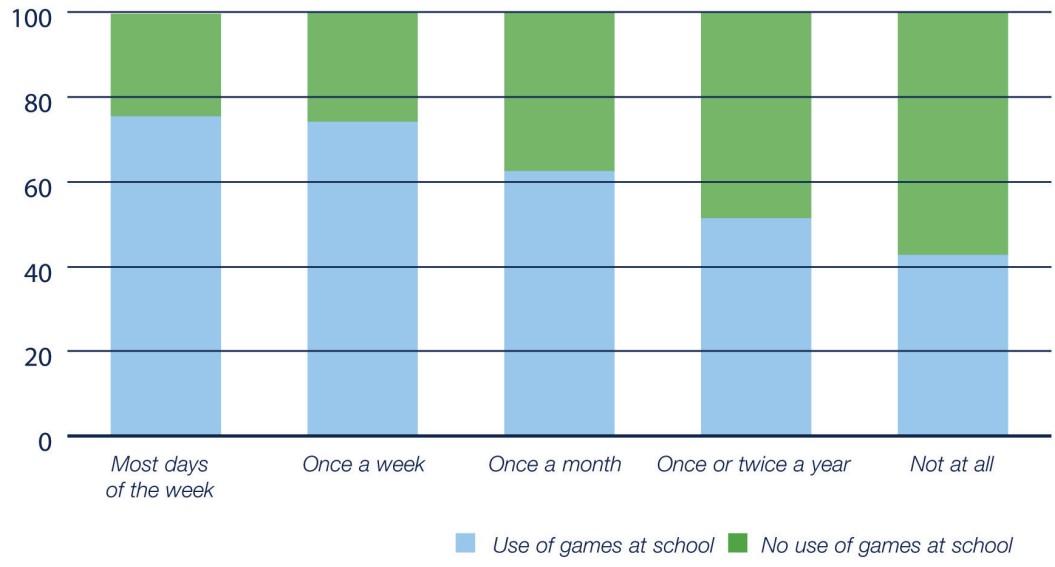
The next graph shows how frequently respondents use ICT in teaching.



About half of the teachers responding to the survey use ICT most days of the week in the classroom; another quarter about once a week. This illustrates that the respondents are "heavy" users of ICT in education, and do not need to be convinced of the use of ICT in teaching. This profile is not surprising since the survey was promoted among teachers with an interest and experience in ICT in teaching.

The following graph shows the relationship between the frequency of the respondents' use of ICT at school and whether or not they use games in their lessons.

Relation between the frequency of use of ICT and the use of games at school



It is obvious from this graph that teachers who use games in their teaching are also more frequent users of ICT in teaching than their colleagues who do not use games in teaching.

Table 4 below shows the relationship between the frequency of use of ICT in teaching and the level of ICT skills of the respondents.

Table 2

Relationship between the level of ICT skills and the use of ICT in teaching						
Frequency of use of ICT in teaching	***Level of ICT expertise***					
	Expert	***Good***	***Moderate***	***Beginner***	***Non-user***	
Most days of the week	94	132	26	1	1	**254**
Once a week	21	61	39	5	1	**127**
Once a month	4	40	36	11		**91**
Once or twice a year	1	6	16	10		**33**
Not at all	1	3	3	3	4	**14**
	121	**242**	**120**	**30**	**6**	**519**

Not surprisingly, in general the higher the level of ICT expertise, the more ICT is used in teaching (and vice-versa).

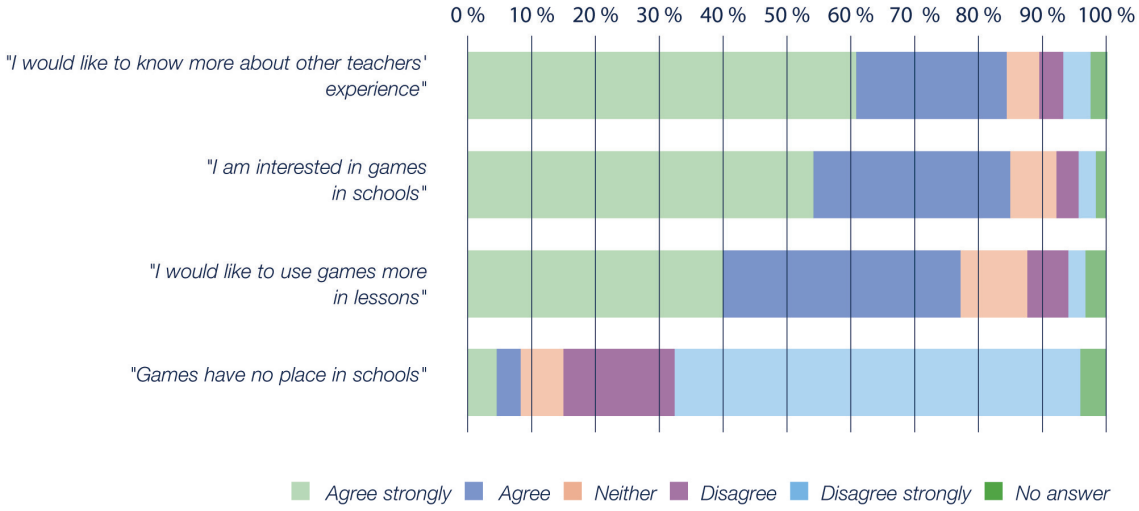
Interest in the use of games in teaching

Respondents were asked to indicate to what extent they agreed with the following statements:

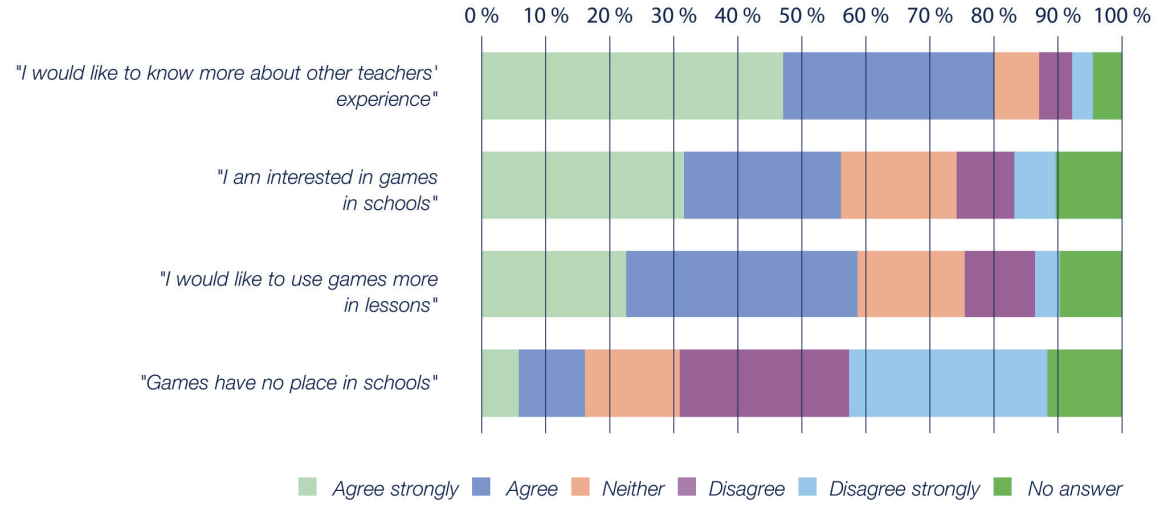
- *"I would like to know more about other teachers' experience"*
- *"I am interested in games in schools"*
- *"I would like to use games more in lessons"*
- *"Games have no place in schools"*

The results are displayed in the following graphs, first for those respondents who said that they use games in teaching and then for those teachers not using games in teaching.

Opinion of teachers using games in schools (N=373)



Opinion of teachers not using games in schools (N=155)



As might be expected, the interest in using games at school is highest among teachers already using games in their teaching. But it is interesting to observe that almost 85% of them said that they would like to know more about other teachers' experience and would like to use games more in lessons. Fewer than 10% thought that games have no place in schools.

Respondents who were not (yet) using games in the classroom also showed keen interest. 80% wanted to know more about other teachers' experience and almost 60% would like to start using games in lessons.

These results suggest that there is still considerable potential for increased use of games in schools.

Profile of teachers using games in their lessons

In this section we look at the profile of the teachers using games in their lessons (N=373).

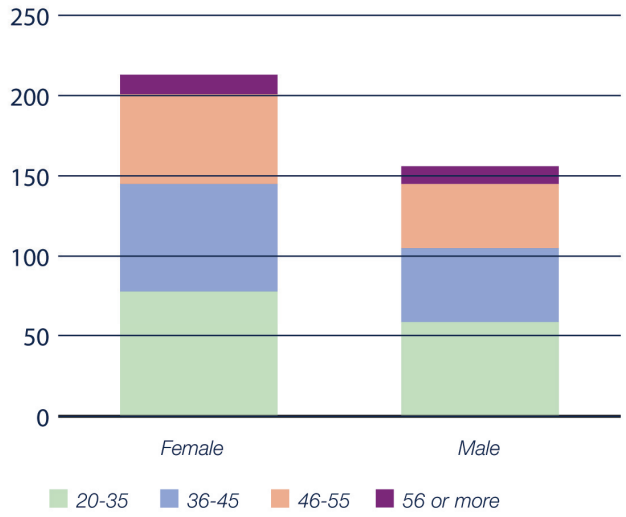
Age and Gender

373 respondents said that they used games at school. The breakdown by age and gender is displayed in Table 3 and the graph below.[2]

Table 3

Distribution by age and gender			
	Female	**Male**	**Total**
20-35	78	59	**137**
36-45	67	46	**113**
46-55	56	40	**96**
56 or more	12	11	**23**
Total	**213**	**156**	**369**

Distribution by age and gender



[2] Of the 373 teachers, 4 did not indicate their gender or age category; the total number in this table is thus 369 (373 minus 4).

Female respondents are in the majority – as indeed in the teaching population in Europe. One may observe that the use of games by teachers decreases by age group. But this decrease is not sharp: teachers of all ages use games in their lessons[3].

Predominant student group and years of teaching

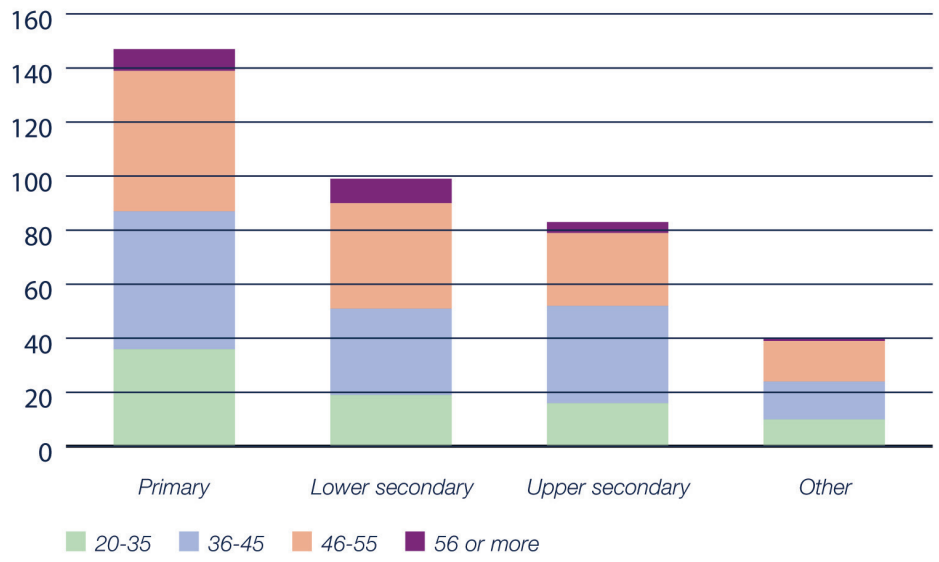
Which types of teachers are using games at school? The survey included questions about their predominant teaching group and how long they had been teaching. The distribution for those two characteristics is given in Table 4 and the graph below.[4]

Table 4

Distribution by years of teaching and predominant student group						
	0-5 years	**6-15 years**	**16-30 years**	**+ 30 years**	**Total**	
Primary	36	51	52	8	**147**	***40%***
Lower secondary	19	32	39	9	**99**	***27%***
Upper secondary	16	36	27	4	**83**	***22%***
Other	10	14	15	1	**40**	***11%***
Total	**81**	**133**	**133**	**22**	**369**	
	22%	***36%***	***36%***	***6%***		

[3] For a correct interpretation of these figures one should be aware of the fact that the age categories defined were uneven and that the relative numbers of teachers in each age category differ by country.
[4] For 4 out of the 373 teachers using games in their lessons, this information was not available.

Distribution by years of teaching and predominant student group



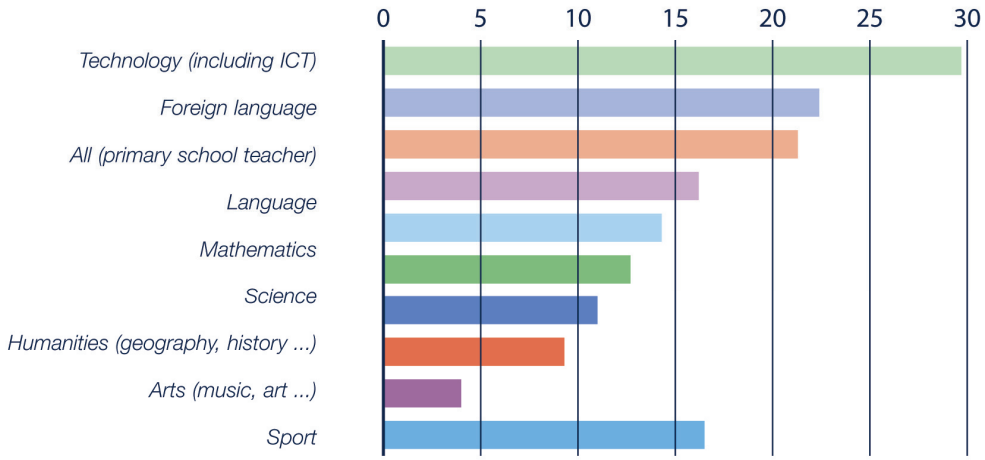
40% of the responses came from primary school teachers and almost half from teachers in secondary schools, fairly evenly distributed between lower and secondary education.[5] The category "other" includes teaching staff in adult education, vocational training and higher education institutions.

It may appear from the data that teachers with less than 5 years' teaching experience are somewhat underrepresented. But in fact the opposite is the case, since the other categories defined included far more teachers. Not surprisingly, fewer teachers with over 30 years of teaching experience responded. One should note that these people became teachers long before computers came into common use.

Subjects taught by teachers using games

The distribution of subjects taught by teachers using games in their lessons is shown in the following graph.[6]

Subjects taught by teachers using games



[5] The boundary between lower and upper secondary education differs between countries.
[6] The total adds up to more than 100% because respondents could mention more than one subject category.

It comes as no surprise that ICT and technology teachers are the group which is best represented amongst the respondents (almost 30%). The second place for foreign language teachers (20%) may have been less expected. But one should consider that in many countries this group is the largest category of teachers, and that there is a large quantity of educational ICT technology for language learning. As will be seen later in this report, games are used a lot in language teaching and learning.

The percentage of people responding *"All (primary school teachers)"* (21%) is lower than the percentage of primary teachers (40% - see §3.2). This is because some primary teachers do not teach "all topics" but rather several of the subjects listed; some also teach only one subject.

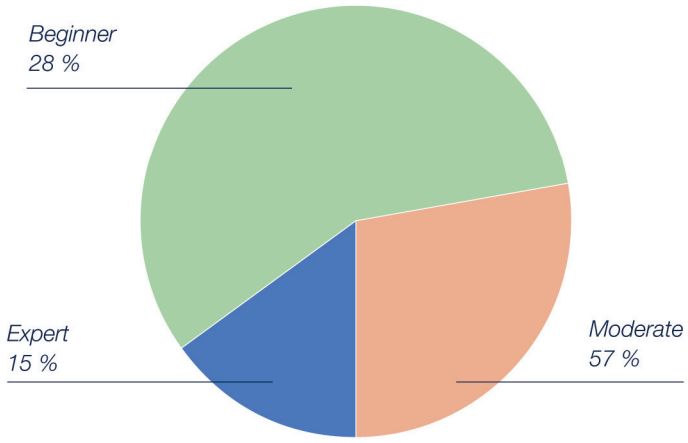
The category "other" includes subjects such as economics and religion. Some teachers also indicated that they were special needs teachers or had a teaching support function.

Game skills level of teachers using games

In the survey, teachers who responded that they used games in their teaching were asked how they rated their game skills. The results are displayed in the graph[7] on the next page.

It is interesting to note that only 15% of the teachers using games in the classroom consider themselves as an "expert". The use of games in teaching is thus not restricted to "gaming experts": teachers with "moderate" and even "beginner" game skills also use games in the classroom.

Game skills level (N = 220)



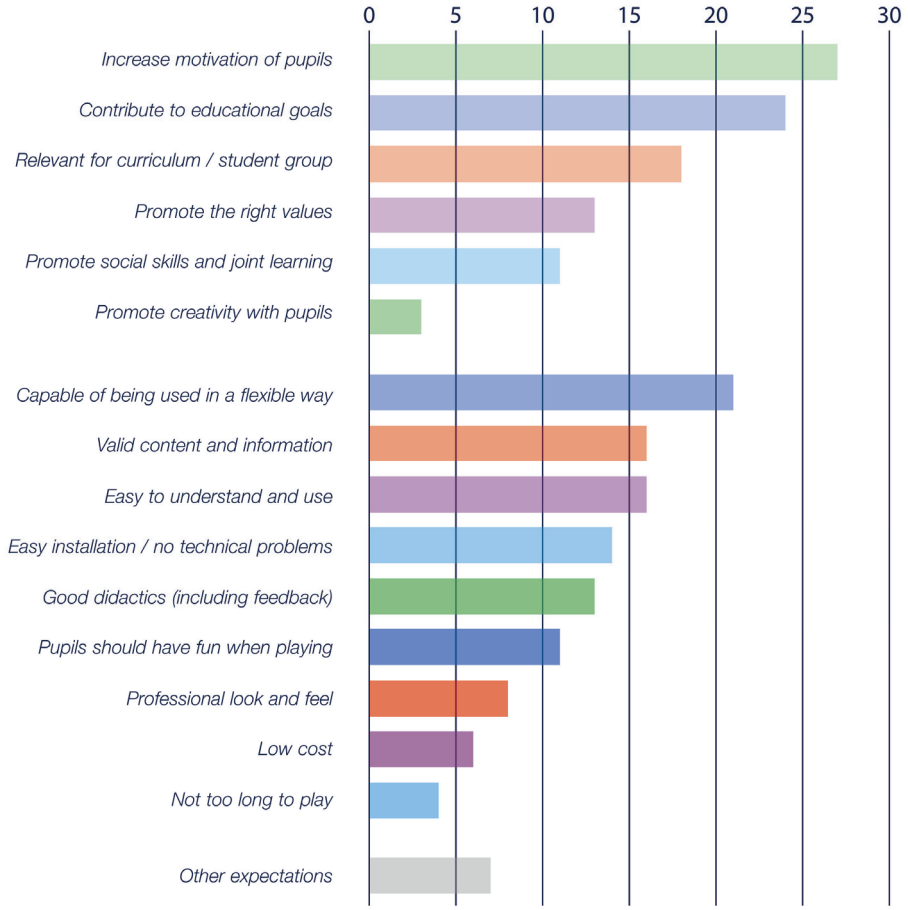
[7] The number of responses (220) is lower than the number of respondents using games. This is related to the fact that about one third of these respondents did not answer this and some other questions.

Why use games in schools?

Expectations from games

In one open question in the survey, respondents were asked to formulate what they expected from games. Expectations were also formulated spontaneously through the answers to other open questions. Overall, over 210 expectations were formulated by some 120 respondents. These expectations have been grouped into 16 categories that are presented in the graph below.

Expectations from games (N = ± 120)



Obviously, teachers have very diverse expectations of games. Several of these have to do with how the use of the game can be integrated in the learning process: games should be tools that motivate pupils and allow them to have fun when playing the game. This could be interpreted as a criticism of some educational games that are seen as rather boring. Teachers also consider it important that games can be used in a flexible way (e.g. different levels, allowing pupils to progress at different speeds, adapting/controlling certain features of the game to make it more suitable, etc.). Several respondents stressed the importance of a good didactic approach (or at least the possibility of using a game in the classroom in a good didactic way), in particular the opportunity for rapid feedback.

Other expectations have to do with the content of the game. The content should be consistent with the educational goals for a particular course, a whole course programme or even the educational vision of the school. The content of the games should also be "valid", i.e. not containing factual errors that would contradict what is taught in other courses. Another clear requirement is that it should be possible to integrate a game into the curriculum and adapt it to the target group (age, special needs). Several teachers in the

survey warned that games should not promote "wrong values", such as violence. Promoting creativity was mentioned as an expectation by some teachers.

Respondents stressed the importance of ease of use. Games which take a long time to get started in the classroom are not very useful. Installation should be simple (also on a network, where appropriate) and there should not be technical problems – although these sometimes stem from the school's ICT infrastructure and expertise rather than the game itself. Some respondents mentioned "low cost", but this did not seem the biggest concern (it may be implicitly expected that games for school should be free or at least fairly inexpensive for educational use).

Two less obvious requirements should also be mentioned. The first is that games – or episodes/levels/ parts of games – should not last too long. It should be possible to fit them in the school timetable, which is often organized around one-hour lessons. And secondly, some respondents indicated that educational games should have more of the look and feel of commercial games, so that pupils associate them with fun and not with an educational tool.

Some quotations

- *"The key is that games must be both meaningful and motivating for children."*
- *"It should be easy to manipulate games with different activities divided into different levels of difficulty."*
- *"There should be plenty of alternative ways to play the same scenario. This enables students to try many options to see what the results are within the 'safe environment' of the game."*
- *"The most appreciated feature is that they can be (easily) modified and adapted."*
- *"Games should have a well researched content with definable goals, relevant to children of today."*
- *"They must show positive values, such as cooperation."*
- *"Games should provide students with challenges that are best solved through collaboration."*
- *"I expect detailed information from the creators about the intended audience in terms of age range or skill level."*
- *"More than anything I want to see sound pedagogical principles behind it - not Lara Croft with worksheets bolted on."*
- *"Games should be educational, but not boring."*
- *"I expect good and positive feedback."*
- "Games should be easy to handle and self-explanatory for pupils."
- "I expect games to be accessible to a range of disabilities."
- "Educational games should be as good as commercially available games."

The purpose of using games in schools

Through the analysis of several open questions in the survey, a picture has emerged of why and for what learning purposes teachers use games.

First of all, they use them because some games are good educational tools to facilitate learning certain subjects and developing certain skills. This will be discussed in the next section.

But there are other more specific reasons as well. Three frequently mentioned arguments are:

- A means to motivate students and raise their interest
- To better reflect pupils' environment (they are used to using computers and playing games)
- To make learning enjoyable for pupils

It is obvious that these arguments are related to each other. The central argument is to use games as a way to attract pupils' attention for particular subjects and motivate them to learn.

Three other arguments that are often put forward:

- For tests, repetition, revision, etc. of topics taught at school
- To take account of different speeds in learning
- As a reward for students
- To enhance active participation of students in the classroom.

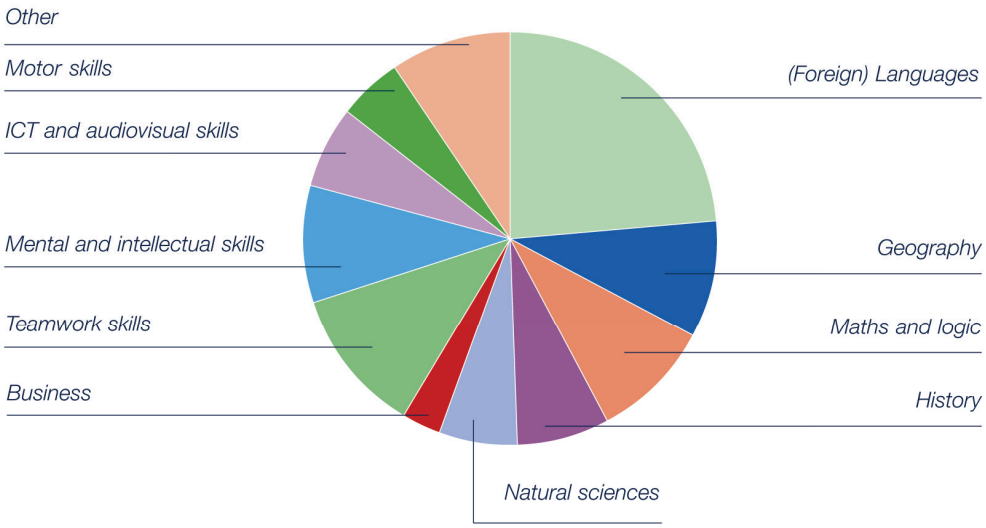
Some quotations

- *"Games can be used as a jump-off for learning processes in many subjects."*
- *"I think computer games are a fabulous learning resource that engages the children."*
- *"Using relevant games is a way of linking with "a world" the kids know and are confident with."*
- *"In my opinion, if students enjoy themselves while learning, they learn better and quicker."*
- *"I use games for consolidating and as an additional exercise."*
- *"I believe learning by playing is the best way to learn new knowledge, because the child learns without feeling he is learning, which is very motivating."*

Subjects and skills for which games are used

Based on the answers to the open questions in the questionnaire it is possible to draw a rough picture of the school subjects in which games are used most. An approximate distribution, based on the answers of the respondents, is shown in the graph on the next page.

Approximate distribution of subjects and skills for which games are used



The clear winners, where games seem to be used most, are language lessons – both mother-tongue and foreign languages. It is estimated that roughly a quarter of the games used in teaching are intended to improve language learning. Other subject areas frequently mentioned are Geography, Maths and History.

Games are also used to develop certain skills. The four categories most cited are teamwork skills, mental skills, ICT skills and motor skills. Several respondents explicitly mentioned that they used games for improving students' teamwork and communication skills.

Some quotations

- *"I love using video games as a teaching aid in language classes because my learners respond to the virtual environment in a positive way as it is non-threatening, there are no/few penalties for making mistakes, and repetitive use increases ability, etc."*
- *"I use the games to support a group in Numeracy lessons."*
- *"SimCity and Civilization are useful for understanding simple cause-and-effect principles in History and Geography."*
- *"Using games benefits team work."*
- *"Games help develop decision-making skills and how to work out different situations."*
- *"I am interested in classroom games so that the child gets self-confidence and skills with computer tools."*

Usefulness of games for particular groups of students

One open question in the survey asked respondents to comment on their successful experience with the use of games for particular student groups. Only about 50 teachers responded to this question. This firstly suggests that games are used for all kinds of students. Indeed, several teachers indicated that, when appropriately used, many or even most games can be used for all kinds of students. Thus, they consider that a good game should be flexible to use and hence should be useful for all kinds of students.

Some respondents, however, reported successful use of games for particular groups of students and mentioned games with which they had had positive experience.

The categories of pupils most mentioned were:

- Pupils with special needs (mental, motor, behavioural, etc.)
- Weaker, less able pupils
- Demotivated pupils
- Boys
- Competitive pupils

Some quotations

- *"I have observed students from 6 to 13 years enjoying (and learning from) games, both the most and least able."*
- *"I work with children in the Early Years and find game playing an excellent way to 'tempt' the reluctant child into participation."*
- *"One group that may benefit the most from games are weaker, less motivated pupils, particularly the boys."*
- *"Games can help students with difficulties and special needs students (i.e., some of the Wii games can help improve psychomotor control)."*
- *"I use games (GCompris, GUT1) for pupils with dyslexia, for pupils whose mother tongue is not German, and for school beginners."*
- *"Sallardore was successful with several home-tutored students with behavioural difficulties - they seemed to connect with it."*
- *"Also it can be experienced as a 'non-devaluing' way of learning for those students for whom reading is not that easy, as lively pictures are often much easier for them to comprehend than written text."*
- *"I teach car mechanics students. For these students, personal relevance is everything. Teaching international relations is a challenge in these circumstances. For these students a first person 'serious game' has proved strongly motivating compared with traditional teaching."*

Obstacles and reasons for not using games

Ranking of main obstacles

The survey included both a closed and an open question about the obstacles to and reasons for not using games in school. In the closed question the survey respondents were given nine possible obstacles to using games at school and were asked to rank them.

The overall result of this ranking is displayed in Table 5 below.

Table 5

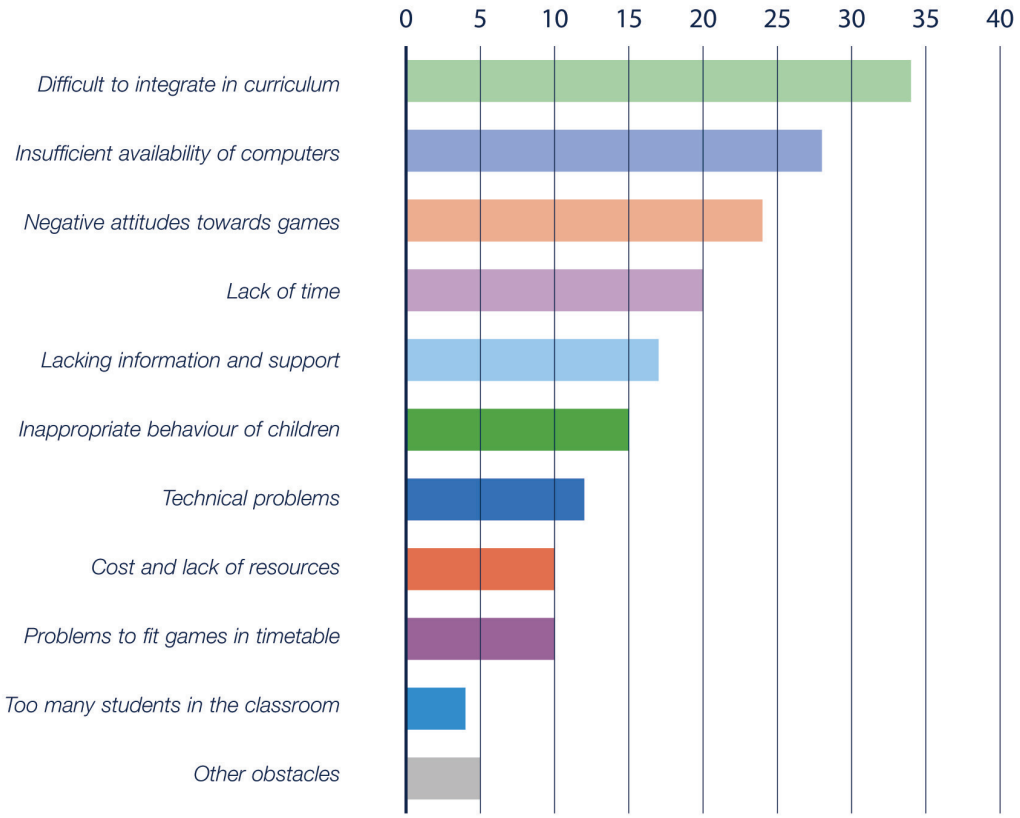
Main obstacles to using games in teaching	
1	Cost and licensing
2	Timetable of the school
3	Finding suitable games
4	Attitudes of other teachers
5	Training and support
6	Inappropriate content
7	Worries about negative aspects
8	Insufficient evidence of value
9	Examinations

A closer look at this "average" ranking reveals that the first three obstacles on the list – cost and licensing; timetable of the school; finding suitable games – were listed most frequently as the main obstacles by respondents. The six other obstacles listed were however also mentioned frequently and the difference in importance between the 4th obstacle (attitudes of other teachers) and the 9th (examinations) is not large.

Reasons for not using games

All participants in the survey – including those who were not using games – were asked in an open question to mention reasons why games were not used, or not used enough. This provided a wealth of data on top of the answers to the closed question mentioned in the previous paragraph. We grouped the answers to the open question in 10 broad categories. The distribution of the number of answers in each category is given in the graph on the next page.

Obstacles for using games in school



Let us compare this information with the obstacles mentioned in Table 5.

"Cost and licensing", the highest ranked obstacle in Table 5, was also mentioned very often in the open question as a reason for not using games. In fact, in most cases respondents referred to ***insufficient computers available*** at school and lack of resources to buy new ones. The cost of software licences was mentioned only occasionally.

Some Quotations

- *"I can't use games because of a lack of means in my state school. There are only two computer labs for 700 students, and the computers are old and out of date."*
- *"At our school we only have one classroom with computers. If we want to use computers in other rooms, we can only take one and only if it is available (we are about 60 teachers!)."*
- *"We don't have the equipment to use games or enough powerful computers for everyone."*
- *"There is only one computer lab in my school, mainly used by maths and IT teachers."*
- *"We don't have enough money to buy games..."*
- *"The main reason for not using games is the resources required."*

The ***timetable of the school***, second highest ranked in Table 5, was also mentioned by many teachers. In fact, three problems are covered by this. First, there is the fact that ***teachers*** have already a heavy job and ***don't find the time*** to prepare the use of games. Secondly, there is ***not enough time available*** within the

timetable, since a lot of topics have to be covered. And thirdly, it is ***difficult to fit the games into the timetable***: either because the computer lab is not available, or because games (or parts/episodes/levels) last longer than a typical lesson.

Some quotations

- *"There is not enough time in class already and too much pressure put on attainment of pupils."*
- *"I don't have much time during curricular hours."*
- *"It is difficult to go to the computer room each lesson."*
- *"The main problem in using videogames in a classroom is time. The duration of the games is much longer than a 50 minutes class."*
- *"The teaching time is too short to use games."*

Many teachers stated that it was ***difficult to integrate games into the curriculum***. This is linked to ***Finding suitable games*** and ***Inappropriate content*** in Table 5. It is often difficult to fit a particular game into a particular course, because of the way the course is structured and because the level of knowledge required and the vocabulary used within the game are not appropriate for a particular group of pupils, or because the games do not match the course objectives very well. Many games also cut across several courses (given different teachers), which complicates matters, especially in secondary schools. A related concern is that many teachers think that there are no good games available for the courses they teach.

Some quotations

- *"Games should be related to the subject, which is sometimes not easy…."*
- *"The use of video games for learning requires a methodology which has not yet been developed to an extent that makes it a sufficient tool for teaching on a broad scale."*
- *"It is hard to find games related to lessons."*
- *"There are not enough adequate learning games available."*
- *"The main reason why I am not using games in my lessons is that there are few games, if any, available at the moment that tie in with the curriculum. This is a shame seeing how much time kids like spending on games and computers. In one lesson I had to teach how to describe one's personality, which involved learning lots of adjectives. Rather boring, until I got the students to do personality/leadership tests on the internet. I've never seen them work so hard."*
- *"Curricular pressure can push games to be just drill and practice and a lot of games look good in schools but actually have limited value. I actually think there's more value in getting students to create games."*
- *"The only obstacle I've found is finding the right game to use that allows sufficient control over the game-playing experience so that I can steer learners towards meeting the lesson objectives through the game."*

Attitudes of other teachers – and, more generally, of school management, parents, etc. – were also mentioned frequently in the answers to the open question. This is linked to the perceived ***insufficient***

evidence of value (cf. Table 5) and the lack of information and support (see below). In some cases there is a more radical rejection of games, which are seen by some as having no place in school. A few respondents in the survey were themselves quite sceptical about the added value of games, based on personal experience.

Some quotations

- *"Although the skills used in games can be complex, games are not normally seen as 'proper work'."*
- *"The problem is teachers, as much as families, who do not accept this kind of teaching practice at all, thinking that playing is not working."*
- *"I find using the computer not useful as there is no contribution to the learning process…. Please show first that a computer has an added value before you start with games."*
- *"The problem is the reluctance of other teaching staff to recognise the potential for using games in education."*
- *"Learning by playing is not very common in the Spanish education system, because of cultural tradition and because it has been overused in some cases, without any objective and control of its practice."*
- *"The time needed compared to the benefit is not always clearly provable."*

Several respondents referred to insufficient or lacking ***training and support***. The main criticism was ***insufficient information*** about good games available and lack of understanding of how particular games could best be used. Support and training were mentioned less often as an obstacle.

Some quotations

- *"I am very interested in games for music and art, but I lack resources, exchanges with other teachers, etc."*
- *"Sometimes there is no information about how to apply games in the learning process. I just try a game out and analyse the results later."*
- *"I want to run a games workshop where pupils get to create their own games but don't know anyone who can deliver it."*
- *"At present, I don't use games because I know nothing about them."*
- *"I find that the biggest 'problem' is where to find the relevant games for various subjects. But I have succeeded in finding a great number by searching the internet."*
- *"Perhaps I need ideas and strategies for using them in the classroom. I think I lack imagination with video games in relation to language learning."*

Worries about negative aspects: from the answers to the closed questions these worries appear to be mainly in relation to the – sometimes – ***inappropriate behaviour of children*** when playing games at school. Some abuse the possibilities offered and/or are difficult to control. This jeopardizes the original intention of achieving particular learning objectives.

Some quotations

- *"I believe that the motivational aspect of games is important in education, but that students shouldn't come to expect to be entertained."*
- *"Games do not bring any unspoken knowledge. Students are interested just in playing and not learning."*
- *"It is necessary to keep them controlled. They chat, they play different games, they look at pornographic pages… just connecting to the internet means the teacher's work doubles."*
- *"It's difficult to use games, because children are distracted a lot…."*
- *"Sometimes it is difficult to find the balance between having fun and learning something."*
- *"Children love the experience. Although last year we found that pupils weren't always focusing on the objectives and were just happy playing. We feel confident that this year we should be able to enable pupils to both learn and play at the same time."*

Examinations were not cited as an obstacle in the open questions. But there were two other reasons that were identified as a possible obstacle for using games. The first is the "***technical obstacles***", in particular school computers and ICT networks working properly, as well as installation problems. The second obstacle which was mentioned a few times was that some teachers have ***too many pupils in the classroom***, which makes it virtually impossible to use games (either because there are not enough computers, or because teachers cannot oversee what is happening).

Some quotations

- *"It is difficult to get the graphics to work. A lot of problems have to do with the graphics of both games online and games installed on the computer."*
- *"Technical reasons, mainly. Computer rooms do not always work properly."*
- *"Access to set-up and installation is not easy."*
- *"There are too many students in the class and it is difficult to monitor it."*

Types of games and how they are used

The survey included an open question about the types of games used. From the analysis of the response to this question it clearly emerged that a very large variety of games are already being used in European classrooms: from puzzles and electronic board games to simulation games and adventure games – in addition to all kind of educational games that focus on a particular subject area or skill.

An interesting observation is that both commercially available games and dedicated educational games are mentioned frequently throughout the survey. In fact, from analysis of the names of the games explicitly mentioned in the open questions, the majority appeared to be commercial games. This does not necessarily imply, however, that commercial software dominates the use of software used in teaching. The first reason is that the respondents are not a representative sample of European teachers. A second reason for taking care in interpreting this data is that educational software is often not positioned and perceived as a "game", but rather as a "software program" or "an educational tool". For instance, some people regard a business simulation program as a game, others do not. This finding may well, however, imply that the educational use of commercial games is more widespread than one may have thought and "competes" with educational software.

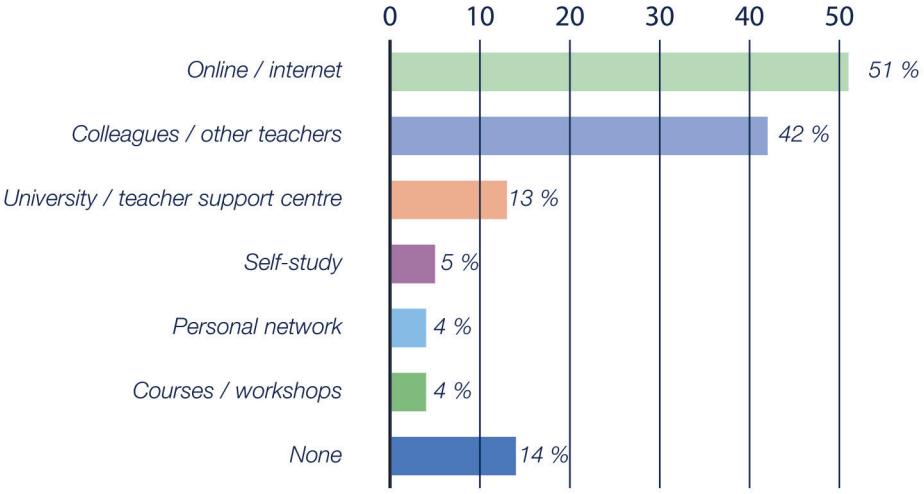
The commercial games mentioned cover a very broad range. To give an idea, a word cloud[8] has been created based on the names of the games mentioned.

[8] Credit to Wordle, see www.wordle.net.

Availability of pedagogical support for integrating games in teaching

One of the questions in the survey was: *"Where do you get pedagogical support to integrate games into teaching?"* Respondents could tick more than one answer category. The results are displayed in the graph below.

Pedagogical support to integrate games in teaching (N=202)



Clearly, there are two main sources of pedagogical support: the internet and assistance from other teachers and colleagues. Other sources of support are universities or teacher support centres, courses/workshops and personal networks (including family and children!).

Impact of the use of games in schools

In the survey, the teachers using games were asked to assess the potential and possible impact of games. Nine different items were listed:

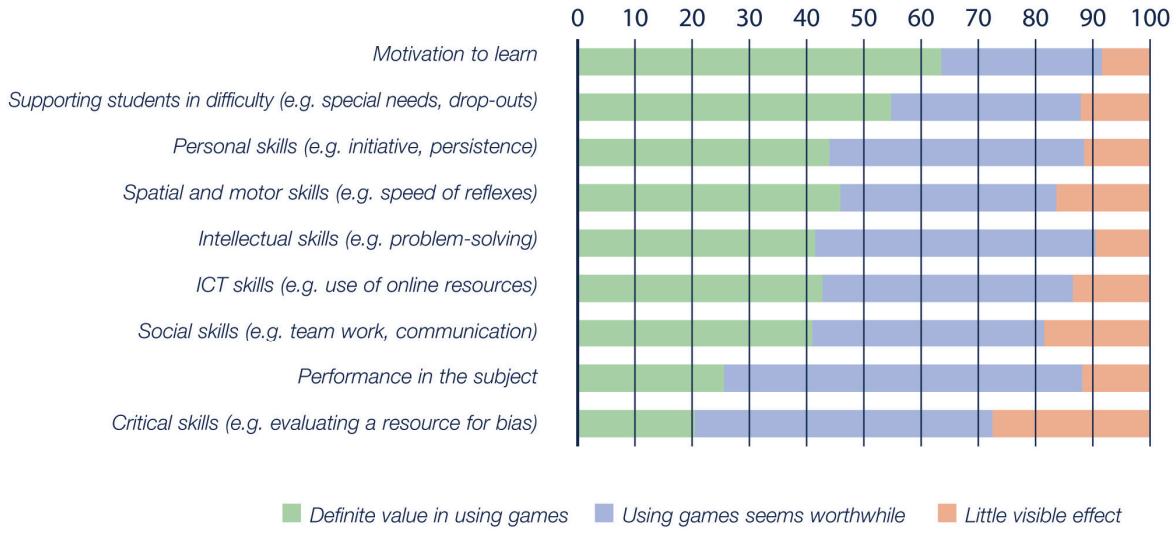
- *Motivation to learn*
- *Performance in the subject*
- *Personal skills (e.g. initiative, persistence)*
- *Social skills (e.g. teamwork, communication)*
- *Intellectual skills (e.g. problem-solving)*
- *Critical skills (e.g. evaluating a resource for bias)*
- *Spatial and motor skills (e.g. speed of reflexes)*
- *ICT skills (e.g. use of online resources)*
- *Supporting students in difficulty (e.g. special needs pupils or work for drop-outs)*

For every item there were three possible answers (only one could be ticked):

- *Little visible effect*
- *Using games seems worthwhile*
- *Definite value in using games.*

The results are displayed in the following graph.

Opinion on educational impact of using games (N = ± 200)



Overall, teachers who use games in teaching are fairly or even very positive about the impact of games on the development of students' competences – and for quite a wide range of them. The teachers are most positive about the contribution of games to students' motivation to learn and in supporting students in

difficulty. In both cases, only about 10% considered that using games has little visible effect. But there are also high scores for personal skills, spatial and motor skills, intellectual skills, ICT skills and social skills.

Only for two of the nine items listed – performance in the subject and critical skills – are fewer than 30% of the respondents definitely convinced of the added value of using games. Even for the competences which, according to these teachers, are least developed by games – "critical skills" – still 20% consider that there is a definite value in using games, and another 50% think that using games seems worthwhile.

In one open question, teachers were asked to comment on the impact of games in schools. Some were sceptical and cast doubt on the impact that could be achieved with games, based on their personal experience; but the large majority of comments were positive. Almost half of the comments were about the positive impact of games on pupils' motivation to learn. This is consistent with the high score of "motivation to learn" in the closed question. Other comments were related to students' increased performance in particular subjects and the observation that special needs students benefited a lot from using games. Several teachers also spontaneously indicated that pupils cooperated better with each other thanks to the use of games.

Some quotations

- *"I teach programming skills by using the Game Maker tool. For me it is a very easy way to motivate students to learn something about object oriented languages, etc."*
- *"Reluctant learners suddenly got motivated when learning through games was set up."*
- *"The students become active and motivated for the subjects at school and they use their competence from home."*
- *"Children with ADHD, etc. immediately respond to using games and concentrate for far longer and are more willing to participate."*
- *"Students with gross and fine motor difficulties have the ability to access sports and compete with others at the same level. Students with behavioural difficulties are far more engaged. For students with literacy difficulties and behavioural difficulties, Sims enables them to take control and have success."*
- *"The children have taken more initiative and have supported each other very well. Helping is not restricted to the teacher only. Very fast the children know who has specific skills in the class."*
- *"The learning group of 9 year olds are having a great experience. The common learning process is overwhelming."*

How are games in schools addressed by education systems?

6. How are games in schools addressed by education systems?

Main findings

Involvement of education authorities

The interest that the education authorities show in the classroom use of educational games varies considerably from one country to another. In Denmark, the Netherlands and the United Kingdom, they give explicit support. It is noteworthy that in these three countries, research in the field of digital games is also relatively well developed. This research actively encourages the initiatives of the education authorities, in which the researchers themselves contribute in some cases. In Denmark and the Netherlands, it is mainly concentrated in universities; in the United Kingdom it is divided between universities and government or independent agencies (Becta, Futurelab).

The main types of approach

Whatever the degree of involvement of the education authorities, four major conceptions of the use of educational games in teaching emerge from comparison of the eight education systems analysed. These approaches do not necessarily each correspond to a particular national situation. Each education system draws to some degree on all the various conceptions, while identifying predominantly with one of them.

Support for pupils in difficulty

This approach sees digital games as useful mainly for pupils who encounter difficulties in cognitive, methodological or social learning (slow learning, lack of organisation in work, resistance to rules and evaluation, etc.). The teacher resorts to digital games preferentially outside normal lesson times, but still within the framework of the school. The teacher chooses digital games because they reconcile the pupil with school learning, allow repetition, identify errors in a non-traumatising way, make the rules of the games easier to accept, help the pupil to understand his or her way of learning, etc.

The current situation of the French education system as regards the use of digital games in teaching is representative of this conception.

A tool for modernizing education

This approach is interested in digital games as an information and communication technology capable of modernising the teaching methods implemented by the education system. It is concerned with the impact on all pupils, without distinction. The education authorities more or less strongly support the use of games in the classroom, depending on the case. Research centres, including some close to education authorities, are developing a number of projects in this area, which feed into new teaching practices. Teachers are relatively open to the use of games in the classroom. They often share the idea that the world of school needs to come closer to pupils' everyday reality (in which such games figure prominently) and that the world of adults and the world of young people should have some references in common. There is also an awareness of the need to (re)motivate pupils in order for them to take in hand their own learning. A policy of informing parents accompanies the use of games in the classroom.

The Netherlands is fairly representative of this approach, as is the DANT project in the Trentino region of Italy. Denmark and the United Kingdom are also to some extent pursuing this approach, but each also has

other objectives (see below). To a much lesser extent, at the level of the support given by the central and regional level authorities and also by teachers, experiments in Austria are looking at digital games as a tool to modernise the education system through personalisation of learning.

A tool for innovation and the development of advanced skills

This conception is particularly strong in the United Kingdom. Like other information and communication technologies, digital games should contribute to the development of advanced skills in creativity and innovation. They should develop self-confidence and social and intellectual skills such as the ability to cooperate and explore, independence, responsibility, initiative and enterprise. They are also used because they allow learning to be personalized.

Institutional support for the use of digital games does not necessarily come from the ministry responsible for education, but rather the ministry(ies) responsible for the development of skills, enterprise or innovation.

A tool to prepare future citizens for the virtual worlds present in society

This more global approach is particularly evident in Denmark, as well as in the Netherlands. The use of digital games is associated with media education. The aim is to teach *about* games, i.e. to explore the different types and categories of games, to compare them with other forms of expression (novels, pictures…), etc. Another aim is to learn *through* games, which then serve as a gateway to the curriculum subjects, such as history, foreign languages, the mother tongue, etc. A final aim is to understand the *world* of digital games, i.e. the target groups, the marketing strategies, the risks associated with over-use, games as artistic and cultural expressions, etc. Teaching about, through and on the background to digital games, as part of media education, is seen as necessary to prepare future citizens who will live in a society increasingly involved in virtual worlds.

Managing the risk associated with digital games through education

Austria and the United Kingdom stand apart in having opted for an approach to electronic games that explicitly takes into account the risks associated with their use and puts mechanisms in place to manage them. In both cases, the approach adopted is that of education in the use of games rather than protection or prohibition. It has, however, been implemented in different ways in the two countries. Austria has opted to develop an agency answerable to the ministry (Bupp), which rates games according to various criteria with a view to better informing parents and teachers. The UK has commissioned a specific report on the question

from a recognised specialist (the Byron Report). This report has led to the adoption of a government action plan to implement a number of its recommendations.

Recent and future developments

As regards the most recent developments and prospects for the coming years, a particular interest in 'serious games' is becoming apparent in several countries (Denmark and France, for example). Different countries do not, however, understand the notion of 'serious games' in quite the same way. In this respect Denmark relies on a certain amount of academic research which defines the specificity of 'serious games' in terms of the role assigned to the teacher, starting at the design stage, and during the playing of the game. Other countries envisage the educational aspect more in terms of the relationship with curriculum content, without placing decisive emphasis on the teacher's role in the game. More in-depth comparative work on this particular point would be especially useful since the questions raised go to the heart of the pedagogical relationship, namely the role of the teacher. Since it is teachers who decide whether or not to use digital games in their teaching, giving them a strong involvement in the designing of a game could have a decisive impact on the use of games in the classroom.

The other pathway for future development concerns the participation of pupils in game design. The Netherlands is particularly interested in this question. Several pilot experiments in the classroom use of games have demonstrated the gains they promote, in terms of motivation, development of key skills, and knowledge of the subject being taught. Generalizing the use of games would however require a very large financial investment in order to develop a technologically advanced offer that meets young people's expectations. An alternative to such investment might be to involve young people in game creation itself; this could moderate their expectations as regards the technical performance of the games used in the classroom.

Denmark

In a nutshell…

Public policy in education has been interested in the use of digital games in schools for a number of years, and regards it as part of the ICT strategy for schools as well as of media literacy for future citizens. Recent developments particularly concern the design of games by the pupils themselves.

Digital games are particularly considered for use in the teaching of Danish and foreign languages. Sufficient autonomy is given to schools for them to decide on the use of games in the classroom. Teachers value electronic games for the increased pupil motivation they expect from them.

Most recent developments focus on 'serious games', i.e. games designed to be used within the formal education system, in line with the curriculum and integrating the intervention of the teacher both in the designing of the game and in its use in the classroom.

Central governmental policy on ICT and digital games in education

For a number of years, at the level of the Ministry of Education, even in the absence of formal or official recommendation, there has been interest in the use of digital games as pedagogical tools in schools. Digital games are regarded as part both of the IT strategy for education and of the media education strategy. This interest in games has been nurtured by a fairly long tradition of research on the potential of games in teaching at university level (for example, at the Centre for Games Research at Aarhus University). Digital games are perceived as useful vehicles for a more enjoyable learning experience for the pupils and students. From the conceptual point of view, this vision of the relevance of games for education is nurtured by the 'flow theory' (also called 'optimal experience'), which refers to:

'A sense that one's skills are adequate to cope with the challenges at hand, in a goal-directed, rule-bound action system that provides clear clues as to how well one is performing. Concentration is so intense that there is no attention left over to think about anything irrelevant or to worry about problems. Self-consciousness disappears, and the sense of time becomes distorted. An activity that produces such experiences is so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous.'[1]

Academic research in Denmark distinguishes between 'serious games', 'edutainment' and 'entertainment games'. 'Serious games' are designed to bring something more than simply fun and integrate in their design itself the intervention of the teacher before, during and after playing; 'edutainment' refers to games used in informal learning environments without any teacher intervention at any stage; 'entertainment games' are only used for fun.

A group of experts, composed of representatives of the ministry, industrialists, university researchers and teachers, is looking at the obstacles and challenges faced by Danish education with a view to reaching a consensus on identifying and defining them. The implications of Web 2.0 for school education and for the IT skills of pupils are a central focus for this group. Developing 'serious games' for more attractive learning processes within schools is part of the recommendations made by this group of experts. Since the main concern is that pupils should learn, the integration of digital games is valued not only because it is engaging but also as a way to start out from their usual environment and cultural habits and to build learning around these. This approach is in turn supported by a Danish tradition of academic research on children's culture.

More recent developments regarding the use of digital games in schools involve exploring games design by pupils and students. Using games in schools has been shown to be successful in terms of skills learning and motivation for the learners. If this use were to become more widespread in schools, many more 'serious' digital games would have to be created. Creating efficient and attractive games is extremely expensive. Nevertheless, these games are the only ones really valued by pupils and students, who have very high expectations in terms of quality and technical level when they are simply consumers of games, whether outside or at school. Current research is consequently looking at the impact on learners' motivation and expectations when they become designers of games. Having this role could be a way for pupils to accept less sophisticated and less expensive electronic games.

Computer-based role playing is also regarded within the Danish education system as a potentially useful tool to develop collaborative learning among pupils.

Computer games, the curriculum and school autonomy

In Denmark, ICT skills, as well as media education, are not taught as separate subjects but have to be integrated into each subject of the curriculum. As ICT tools, computer games figure in the curriculum as possible pedagogical tools, for example for teaching Danish and English, especially to develop communication skills and also the critical sense of future citizens. In the case of the teaching of Danish, another focus is related to character-reading skills.

There is no structured partnership between games publishers and education policy makers, but relationships exist, for example through the group of experts mentioned previously. Some money is made available by the ministry to develop new products, for English teaching for example, and games development could be financed this way.

At institutional level, schools interested in using digital games are entitled to use their budget to buy licences and games. Direct contacts between schools and game publishers sometimes exist but are rather rare.

Teachers and digital games

More and more Danish teachers are interested in games. Their relevance is considered with a view to increasing pupils' motivation, providing better schooling, helping the weakest learners and challenging the brightest ones. Learning to plan, solving problems, experimenting and cooperating with other pupils or with the game are skills considered as particularly developed by the use of games in the classroom.

The fact that students feel they master digital games, in most cases better than the teacher, is viewed by some teachers as an interesting situation from the pedagogical point of view. Digital games are also valued as one of the few domains where teaching is able to 'meet' the pupils in their day to day reality. Relating teaching to games means that there is no longer a struggle to persuade the pupils of the interest and the relevance of the learning. Teachers prefer students to apply their skills to objects that are part of their world rather than objects outside of it, while being at the same time fully aware that different types of games support the development of different skills. Within this approach, teachers do not consider the use of games in the classroom as 'playing' but as analysing games.

There is nothing centrally defined or organised at the level of initial training or of in-service training in relation to the use of games in schools. Initiatives from the ground are nevertheless happening and in-service training sessions on how to use digital games in the pedagogical process are organised in response to a growing demand from teachers. Dissemination of good practices is not organised in a structured way either, but comes informally from the ground through exchanges between teachers, communities of practice, etc.

When they use digital games in their teaching, teachers are used to dedicating specific attention to fully informing the parents of the pupils at each step in the process.

Future development

In-depth investigation of 'serious games' is developing at research level with the support of the Ministry and as a follow-up to a recommendation formulated by the group of experts mentioned above. These serious games are intended to be specifically designed for the formal learning system. For this reason, the intervention of the teacher is planned from the design phase and has a central role in the use of the game. The focus is on developing educational design for serious games and identifying whether they facilitate learning. A collaborative partnership between industry and academia is taking place with a view to this objective, mainly focused on foreign languages, history and social sciences, as well as health subject teaching and learning.

Further information:

Relevant blog entries on the Danish weblog on EMU.dk - the Danish Education Portal:

- "Danish experiences with games and learning presented for European teachers!"

  http://tinyurl.com/chx7q5

- "Denmark's Game Designers to come?"

  http://tinyurl.com/cer2ue

- ".. og tilbage til virkeligheden?" (.. and back to reality)

  http://tinyurl.com/cjg64a

- "Computerspil i undervisningen? Ja, men hvor får vi hjælp og inspiration?" (Games in schools? Yes, but where do we get help and inspiration?)

  http://tinyurl.com/cglntu

United Kingdom

In a nutshell…

There are currently several interrelated policy agendas driving an interest in games-based learning in the UK, including: a focus on empowering young people and their families with the skills and knowledge to manage risks themselves and make the digital world safer; the development of higher-level skills for creativity and innovation; and the enhancement of learner-parent collaboration.

The new National Curriculum for England at key stages 3 and 4 (2008) and Scotland's new Curriculum for Excellence (2009) fully support teachers' creative autonomy, allowing them the freedom and flexibility to innovate and experiment with new tools, including games. Scotland's curriculum explicitly mentions playing and learning with 'electronic games', both to develop specific skills and to learn game design.

Teachers in the UK have been interested in games-based learning for a number of years, but whilst there are isolated examples of innovative schools using games in various subjects at both primary and secondary level, this remains rare (except in Scotland, where it has become mainstream).

The Byron Review[2] calls for more evidence of demonstrated learning outcomes on which to develop an independent accreditation scheme for game-based learning software, to help teachers and parents make informed choices about using games in the classroom and at home.

National ICT priorities and the potential place of digital games

There are currently several interrelated policy agendas driving an interest in games-based learning in the UK.

From protecting to educating young people for a safer digital world

In September 2007 the UK Government's Department for Children, Schools and Families[3] (DCSF) and the Department for Culture, Media and Sport[4] (DCMS) jointly sponsored the psychologist Dr. Tanya Byron to lead an independent review to help parents and their children get the best from new technologies while making them aware of inappropriate or harmful material. The Byron Review recognizes that digital games offer potential cognitive and educational gains for children and young people, in addition to being fun. It points out their ability to engage children and young people in their learning, highlighting the range of exciting interactive experiences they offer. The Byron Review is significant in moving the concern away from 'protecting' young people from digital games to 'educating' them about them. By making them 'media literate' we empower them to manage risks themselves and make the digital world safer. The review fully supports efforts to explore the use of digital games for learning and development, and encourages building on research into their educational benefits and to better understand the nuances of games[5] which can potentially influence their impact. The review recommends that Government supports dialogue between the games industry and the education sector to identify opportunities for the benefits of game-based learning to be evaluated in different educational environments. Despite their apparent potential, the review emphasizes the current lack of the hard evidence needed to persuade policy makers of their educational significance. On 24 June 2008, a cross-government action plan was published to implement the recommendations of the Byron Review, including a focus on the role of schools and other services for children and families that can help equip and empower children and their parents to stay safe online, and on how government will work with industry to improve information and support to parents on video games.

The development of higher level skills for creativity and innovation

In March 2008, the UK Government's Department for Innovation, Universities and Skills[6] (DIUS) published the Innovation Nation White Paper[7] arguing that new technologies (including digital games) must play a role in enhancing the development of learners' 'higher level skills' to foster creativity and innovation. This is in line with the government-commissioned Leitch Review of Skills,[8] which emphasizes the need for learners to develop 'world class skills', and the DCSF's current focus on developing an innovative and enterprising mindset amongst young people. Digital games are understood as supporting the development of 'higher level skills' such as collaboration, independence, exploratory and iterative learning, as well as the skills of innovation and enterprise, rather than simply reinforcing the existing curriculum. Their added value is in their ability to develop these more elusive skills, which are possibly more difficult to develop through traditional learning tools. The UK's interest in how digital games can foster the development of higher level skills is in line with broader educational and children's services policies, such as the Qualifications and Curriculum Authority's[9] (QCA) emphasis on 'Personal, Learning and Thinking Skills'[10] (discussed below), and the Government's *Every Child Matters*[11] policy, which emphasizes the importance of 'personalized learning' to best meet every individual child's unique learning needs. Indeed, the Byron Review explicitly recognizes that digital games may provide personalized learning solutions for those who have difficulties accessing traditional learning methods or for children with specific sensory or physical needs.[12]

The development of learner-parent collaboration

The Home Access to Technology Taskforce Report[13] was published in September 2008. It identified educational benefits to investing in home access to technology for learners, as well as additional personal, social and financial benefits for families and their communities. As a result of this report, Ministers have committed £300 million from November 2008 to ensure that all children in England have access to a computer and the internet at home. This will ensure that all children, including the socially disadvantaged, have the opportunity to engage in informal learning by using digital technology (including digital games). Since June 2007, families are now under the responsibility of the Government's department for education, reflecting the current importance placed on enhancing learner-parent collaboration around educational activities.[14] Research suggests that new technologies, including digital games, heighten the potential for parents and children to engage and collaborate in learning activities together. Family learning is seen as important, as not only does it increase children's development, but also engages adults in lifelong learning.

Digital games and the curriculum

ICT is included in all areas of the National Curriculum for England from ages 5-16, as a subject in its own right as well as an educational tool.[15] No specific reference to digital games is made in the curriculum. However, games are considered to have a potential role in supporting the 'Personal, Learning and Thinking Skills' (PLTS) which underpin the curriculum. Together with English, mathematics and ICT, these competences are considered to be the most important to provide young people with a platform for employability and further learning. The PLTS include: team working, independent enquiry, self-management, reflective learning, effective participation and creative thinking. Research argues that these are precisely the skills pupils can develop while playing digital games.[16] In 2000, the Royal Society for the encouragement of Arts, Manufactures and Commerce[17] (RSA) developed the 'Opening Minds Framework'[18] through which schools can deliver the content of the National Curriculum in a creative and flexible way, to ensure young people are equipped with the real world skills they need as citizens of the 21st century. This flexible, competence-based curriculum framework is particularly conducive to games-based learning as subject boundaries are less defined than in traditional curriculum teaching, allowing various skills[19] to be developed through the exploration of common themes. The Opening Minds Framework is now being used by over 200 schools across the UK and is growing rapidly.

In September 2008, the new National Curriculum for England at key stages 3 and 4[20] came into force, focusing on giving greater flexibility to schools to implement personalized learning and assessment strategies, and aiming to equip young people with the skills to become 'successful learners', 'confident individuals', and 'responsible citizens'.[21] Scotland's new Curriculum for Excellence,[22] published in 2009 and currently in its initial phase of implementation, is also based on these principles.[23] Both the new English and Scottish curricula fully support teachers' creative autonomy, allowing them the freedom and flexibility to innovate and experiment with new methods. Learning and Teaching Scotland[24] explicitly articulates 'how computer games can help develop the four capacities' identified in the curriculum, on the website of *The Consolarium* – the Scottish Centre for Games and Learning.[25] 'Glow'[26] is Scotland's national intranet for education, where teachers, learners, parents and the wider school community can find online digital resources and activities, including games, and create and share digital content with one another. The 'experiences and outcomes' curricular document, part of the Technologies area of Scotland's Curriculum for Excellence, explicitly mentions the use of 'electronic games' under the section on 'computing science contexts for developing technological skills and knowledge'.[27] The learning outcomes in this area are expressed under levels of increasing difficulty:

- ***Early and First level:*** *I am developing problem solving strategies, navigation and co-ordination skills, as I play and learn with electronic games, remote control or programmable toys.*
- ***Second level:*** *Using appropriate software, I can work collaboratively to design an interesting and entertaining game which incorporates a form of control technology or interactive multimedia.*
- ***Third level:*** *Using appropriate software, I can work individually or collaboratively to design and implement a game, animation or other application.*
- ***Fourth level:*** *By learning the basic principles of a programming language or control technology, I can design a solution to a scenario, implement it and evaluate its success. I can create graphics and animations using appropriate software which utilise my skills and knowledge of the application. I can use features of software to create my own animation which can then be used to create an animated sequence.*

Curriculum for Excellence (2009), Experiences and Outcomes, Technologies Area, p. 7

Teachers and digital games

Teachers in the UK have been interested in games-based learning for a number of years, and the British Educational Communications and Technology Agency[28] (BECTA) states that, according to recent surveys, whilst there is not universal support there is a high level of interest in using games for learning.[29] Examples of the learning potential teachers have cited include the development of spatial awareness, dexterity and fine motor skills, the improvement of eye-hand coordination and the ability to respond quickly and accurately. Digital games are used in both primary and secondary schools, but more so in primary schools due to less exam pressure and timetable constraints. Where they are used, digital games support classroom activities in a wide range of subjects such as science, engineering, English, mathematics, history, citizenship and foreign languages. For example, games involving sports management may be used to support mathematics, or alternatively games may be analysed like a film or piece of literature to support media literacy in English lessons. There have been various pilot studies and guidance documents to advise teachers how to use digital games in the UK,[30] and there is an accompanying growing interest from the games industry to tap into their educational potential.

Despite isolated examples of innovative schools using games, their use in British classrooms remains rare (except in Scotland, where it has become mainstream). The Byron Review identifies the current barriers to fully integrating the use of digital games in classroom practice as including: lack of proven evidence of the impact of games on learning, resistance or ambivalence of schools towards being involved with 'games', difficulties in identifying particular games relevant to the learning outcomes of the National Curriculum, the need for effective support materials and training for teachers, and the practical difficulties in using software that is not designed for educational purposes or a classroom environment. The Report advises that in order to overcome these issues, more dialogue between games developers, educational resource developers and educators is needed.

Future development

The learning potential of digital games is most definitely on the UK policy radar at the moment, as a result of the influential Byron Review. This has caused national research organizations such as Futurelab and Becta to invest resources into exploring their educational potential further, both in the classroom and beyond. Becta has commissioned Futurelab to produce a new study on 'Games and Learning' to be published later in 2009, to update the information gained from surveys and interviews with teachers and pupils undertaken for the earlier study, 'Teaching with Games' (2007). Becta has also commissioned Futurelab to undertake a second study entitled 'Families and Computer Games – Guidance for Parents', illustrating the UK's interest in maximizing the educational potential of digital games across public and private spheres and throughout the lifelong learning continuum. As regards future developments in this area, the Byron Review states the following:

> *Based on any future evidence of demonstrated learning outcomes, consideration should be given to the development of an independent accreditation scheme for game-based learning software. Consideration of games-based learning resources needs to be part of a broader approach to the development and evaluation of digital learning resources. This would ensure consistency in addressing agreed educational outcomes (e.g. numeracy, literacy, and problem solving skills) aligned with Government objectives. This would also enable practitioners to make informed choices about using games in the classroom, and help parents choose games for their children based on positive learning outcomes as well as classification. Evaluation or guidance frameworks may also help games developers who are interested in educational opportunities identify ways in which games may be designed to support learning.*
>
> Byron Review (2008), p. 189

Further information:

- See relevant publications and web links listed in the endnotes of this section.

France

In a nutshell…

No official text mentions the use of electronic games in the French education system. Some implications can however be drawn from the texts relating to teachers' pedagogical freedom, experimentation within the institution, and learning support activities. As regards the system of public support for the development of multimedia products for teaching, very few electronic games have qualified, because of the poor quality of the designs so far submitted.

Teachers, head teachers and inspectors generally show very little interest in the use of electronic games in teaching. Greater interest is shown in so-called 'serious' games and/or their use in certain areas of education.

Developments now under way in the education system may open the way for innovation and therefore indirectly for the use of electronic games in schools. These are: the emphasis placed on key skills; changes in the teaching of the sciences; learning support; the allowance made by the education system for the skills learned by pupils outside school; and the arrival of a new generation of teachers.

The statutory texts and the use of electronic games in the education system

Nothing in the official texts either excludes or recommends the use of electronic games in the French education system. As in most other countries, they say nothing explicitly either for or against the use of electronic games in the educational process organized by the school.

A teacher who wants to use electronic games in his or her lessons can point to various statutory provisions.

- *The principle of the teacher's pedagogical freedom*
  This principle, enshrined in law, allows the teacher to use the teaching tools of his or her choice. This freedom is, however, strictly contained by curricula that have to be followed; these are increasingly defined in terms of skills to be acquired rather than content to be transmitted

- *Statutory provisions in favour of innovation*
  Article 34 of the French 2005 Education Act (*Loi d'orientation et de programme pour l'avenir de l'école*) provides for experimentation, especially at the level of the pedagogical organization of the class, school or establishment. Experiments are also encouraged in the areas of subject teaching, interdisciplinarity, cooperation with partners in the education system, and exchanges or twinning with schools in other countries

- *Statutory provisions regarding learning support*
  Since the start of the school year 2007-8, two hours of learning support are provided by the school, on four days a week after normal classes, from 4 p.m. to 6 p.m., for pupils who wish to take part. This support was initially limited to lower secondary schools in educational priority areas, but from the school year 2008-9 it has been made general and is now being progressively implemented in primary schools. As well as help with homework and class work, the text outlining this measure also recommends access to sports, cultural and artistic activities, and to information and communication technologies. It encourages the creation of more individualized learning spaces potentially more open to activities based on play, in particular through the digital media

The place of electronic games in policy tools favouring ICT

In a general way, official policy is currently concentrated on generalizing tried and tested practices. The aim is to reach all pupils through all teachers, in all subjects, and including support teaching (see above).

In this context, various policy tools favouring ICTE (Information and Communication Technology in Education) are being implemented. What is – or what could be – the place of electronic games in the initiatives that are more especially concerned with the development of multimedia products?

Alongside two major tools of the policy in favour of ICTE, one for pupils – the IT and Internet Certificate B2i (*Brevet informatique et internet*) – and the other for teachers – the IT and Internet Certificate C2i2e (*Certificat informatique et internet*, level 2, for teachers) – various tools focused on multimedia products have been created, including in particular: an "RIP" label (RIP: "Recognised as having educational value by the Ministry of National Education").

With a very few exceptions, mainly involving simulations, these measures have not yet been extended to electronic games. Many projects have been submitted, especially for the RIP label; they have not been approved, generally because their content was considered too weak.

- The 'RIP' label is awarded to multimedia products with an educational purpose in several subjects or areas. It was devised to guide teachers towards software and multimedia products that meet the needs and expectations of the education system. They are recognized as such after assessment, by teachers and specialists in the field, of the quality of their content, their ergonomics and the relevance of the use of ICTs. Over 700 products currently carry the RIP logo.

- The Digital Publishing for Teaching project (*SCHENE: Schéma de l'édition numérique pour l'enseignement*) aims to heighten awareness of what teachers require and to provide publishers with the transparency necessary to produce the content, principally accessible on-line, which is needed by the national education system, for each subject and level. Managed by the Ministry's Sub-Directorate for Information Communication Technology in Education (SDICTE), the project is based on the work of subject groups made up of inspectors, education office ICTE advisors, teacher trainers, and trainee teachers. Their work has led to the definition of needs for digital resources and calls for tenders that enable publishers to submit projects and receive financial support for the development of those that are accepted.

- The USB key distributed to new teachers in their first year of teaching is intended to enable them to discover the digital educational resources, both free and commercial, available in their subject area. From 2008, all school subjects are covered.

Teachers and digital games

In general, teachers, school heads and inspectors show little interest in electronic games in the educational process. When questioned, teachers express few needs in this area, except for ecosystem simulations and in economics and social-science teaching at *lycée* (upper secondary) level. Electronic games are, however, more often used in primary schools, in the first years of junior school.

The idea that learning requires effort remains deep-rooted, although the cognitive sciences have shown that pleasure is an important motivating factor. The widespread association of electronic games with violence is another factor behind the rejection of these tools among educators. The use of the umbrella term 'electronic games' is also seen by some people as creating a confusion that hinders the development of interest in the

use of electronic games in the education system. The term is used to cover software products as diverse as simulations, 'fun' games, strategy games, virtual networks, etc.

The use of games, when they are defined as 'serious' and involve simulations, is more widespread in some subjects, particularly foreign languages, economics and the sciences. Simulations and their exploitation fit more naturally into the knowledge, know-how and attitudes required for mastery of these subjects. The concept of 'serious games' is, however, controversial in itself, since the mere juxtaposition of the words 'serious' and 'game' is a heresy in some people's eyes.

Prospects and challenges

Many initiatives have been undertaken in France to modernize the education system through the introduction of ICTE. Various reports have shown that these measures have not necessarily added up to an overall policy. The authorities have made many recommendations concerning hardware but very few about software. Particularly as regards the use of electronic games in the educational process, there has been little practical experience and little research. The subject has, however, been taken up in several recent publications, and the Institut National de Recherche Pédagogique (INRP) is currently setting up a working party.

Prospects favourable to innovation in general are opening up. Could this lead to increased interest in the use of electronic games in education? They include for example the definition of curriculum objectives in terms of competences to be attained (interpersonal and social skills, civic awareness, initiative, etc.) and the search for teaching tools to develop these skills. Other new directions include allowance for pupils' differentiated needs (personalisation) and the development of the means of providing support, such as the 'open school' (4 p.m. to 6 p.m.). Another is the interest in new teaching aids to counteract pupils' observed difficulty in applying theoretical knowledge to practical situations or transferring it to other areas, especially in the sciences. As regards simulation games, the interest of teachers and the education system is currently developing in respect of environment and sustainable development.

Whether or not they are integrated into the education system, electronic games are part of French pupils' everyday lives: 96% of them use electronic games. Young people come into the education system with skills developed through the use of these games. Little is known about these skills; some, particularly in terms of representation, may be erroneous and require revision, even correction, by the education system. How can we tackle these issues and teach young people to reflect on them, if electronic games are left behind at the door of the school? This is a concern expressed by some players in the education system, albeit a minority.

Others stress the fact that the new generations of teachers are sometimes themselves electronic-game players and are active in virtual social networks. They are capable of showing more openness towards these tools as a pedagogical resource and of being more familiar with the environment in which their pupils move at this level. How long can the education system, by choice or not, remain impervious to this cultural shift?

The 'Digital France 2012' plan, drawn up by the ministerial department for forecasting, evaluation of public policies and development of the digital economy, was published in October 2008. It does not specifically target education. Six measures among the 150 or so that it puts forward directly concern electronic games, and some mention the potential contribution of electronic games, and more particularly of serious games, as tools for innovative learning in health and education.

Further information:

- 2005 Education Act (Loi d'orientation et de programme pour l'avenir de l'école), L 2005-380 of 23/4/2005, published in the Journal Officiel of 24/4/2005, Chapter IV - Dispositions relatives aux écoles et aux établissements d'enseignement scolaire, Article 34: http://www.education.gouv.fr/bo/2005/18/MENX0400282L.htm (in French)
- Information on the introduction of learning support: http://www.education.gouv.fr/bo/2008/25/MENE0800453C.htm (in French)
- Information on the RIB label: http://www.educnet.education.fr/en/resources/rip-label (in English)
- Information on the SCHENE: http://www.educnet.education.fr/en/resources/schene (in English)
- Information on the USB key for new teachers: http://www.educnet.education.fr/en/resources/usb-key (in English)
- Report on the e-Educ working party for the development of digital resources in schools (May 2008): http://www.education.gouv.fr/cid21337/pour-developpement-numerique-ecole.html (in French)
- Information on the B2i: http://www.educnet.education.fr/en/training/b2i (in English)
- Information on the C2i2e: http://www.educnet.education.fr/en/training/c2i-certificate (in English)
- Digital France 2012 – Development plan for the digital economy: http://francenumerique2012.fr/ (in French)

Italy

In a nutshell…

No official document mentions the use of electronic games in the classroom. The educational virtues of games as such are, however, mentioned, especially as regards primary schooling. A few isolated initiatives have been launched with the support of the education authorities (video games competitions; a declaration of intent between the Ministry of Education and the Italian Gaming Software Publishers Association: educational content using electronic games available on the ongoing training platform PUNTO EDU, etc.).

In general, teachers are not very interested in the potential of electronic games that might be used in the classroom, some because they feel they have not fully mastered the technologies in question, others because they reject electronic games in principle, still others because experimenting in general, in any form, is not something they are familiar with.

The overall situation therefore appears very mixed – some innovative experiments, in a context of a decided lack of interest. Like most education systems, the Italian system is evolving. It remains difficult to predict what this evolution will mean for the classroom use of electronic games.

The education authorities and the use of electronic games

Since the late 1990s, Italian schools have enjoyed considerable autonomy. The most recent official documents, distributed nationally from summer 2007, do not prescribe an obligatory curriculum. These documents are the following: *'Indicazione per il curriculo per la scuola dell'infanzia e per il primo ciclo di istruzione'* (Curriculum guidelines for the primary school and the first cycle of teaching) and *Il nuovo obbligo di istruzione: cosa cambia? - la normativa italian dal 2007* (The new obligatory schooling: what does it change? The Italian norm from 2007). Their aim is to provide useful suggestions for schools as regards the skills profiles expected of Italian pupils and how they are to be attained.

These documents, which are supposed to be the teachers' main reference texts, make no mention at all of electronic games or their use. There are however several references to the use of games (not necessarily electronic ones) as a teaching tool that can be useful in developing social skills. Games are also recognised as corresponding to a need in the child. In this sense, nothing prevents a teacher who wants to use electronic games in a teaching context from doing so.

Some official or semi-official initiatives have particularly concerned the classroom use of electronic games.

- In February 2007, a joint declaration of intent between the Ministry of Education and the Italian Gaming Software Publishers Association (AESVI) introduced a form of cooperation between the two parties concerned. Electronic games are recognised there as capable of contributing to education. Joint initiatives are envisaged to distribute information in schools about the first European system of self-regulation for gaming software publishers, which rates video games according to content and the corresponding age-group (PEGI – Pan-European Game Information).

- In September 2007, a major competition entitled 'Io & il videogioco' ('Video games and me') was run for all primary and secondary schools. The aim was to use video games as a multimedia teaching tool in various subjects, such as history, civics, English, science and music.

But electronic games generally remain notably absent from official documents and websites such as the portals of the Ministry of Education or the *Osservatorio Tecnologico per la Scuola* (Observatory for technologies in schools).

Teacher training and electronic games in the classroom

ANSAS (*Agenzia Nazionale per lo Sviluppo dell'Autonomia Scolastica*; formerly INDIRE) is responsible, *inter alia*, for the ongoing online training of teachers throughout Italy. Among its most significant initiatives is the setting-up of an online training platform, PUNTO-EDU. In the last few years, ANSAS/INDIRE has trained thousands of teachers in ICTE. Some initiatives have involved the introduction of electronic games into the teaching process.

A major effort to train teachers in ICT has been undertaken by the education authorities. However, teachers have not been obliged to undertake this training. Large-scale training plans have been implemented, for teachers of English and primary teachers for example, in conjunction with television. But these plans have not been extended to technical and vocational education.

Despite this investment, a certain number of Italian teachers do not seem to have attained the level of familiarity with ICT required to make full use of them. This makes it difficult for them to be interested in the didactic potential of educational software or electronic games.

More generally, moreover, there are limited incentives to encourage teachers to discover and try out new teaching practices.

In addition, some resistance is based on prejudice against electronic games and fear of the supposed risks. Such attitudes make it difficult to reflect on the potential value of electronic games as teaching tools.

Prospects and challenges

The use of electronic games in the classroom presents a very contrasting picture, in which a few ground-breaking experiments co-exist with a total lack of interest in some quarters.

The causes of this lack of interest have been mentioned above. Among these experiments, one can point to the IPRASE project, presented as a case study elsewhere in this report. It illustrates in particular the interest of involving teachers in research and experimentation activities and also of developing communities of practice among teachers.

The Italian education system, like those of most other European countries, now defines its curriculum objectives in terms of competences or skills to be attained rather than content. The search for teaching tools to develop these competences is seen in Italy, as elsewhere. Moreover, in late 2008 the Italian statistical office ISTAT published the findings of a survey on the daily lives of children and adolescents in Italy. It is clear that they are making ever greater use of new technologies in their everyday lives, at ever younger ages, whether it be mobile phones, computers, internet access or electronic games. Using the potential of these technologies to improve education and enabling these young people to encounter as stimulating an environment in school as outside are challenges which the education system will have to respond to. A growth in interest in the use of electronic games in schools is a possible, but not guaranteed, consequence of this.

Further information:

- IPRASE website:

  http://www.iprase.tn.it/

- INDIRE website:

  http://www.indire.it/

The Netherlands

In a nutshell…

Using digital games as attractive learning tools to re-engage disaffected learners received a lot of attention and investment in the Netherlands in 2006, with Kennisnet[31] taking an active role in research and pilot projects in this area. Digital games, like ICT in general, are understood by the Dutch education system as a tool to support educational priorities, including reducing the high drop-out rate of young people from formal education. National initiatives to promote the use of digital games in schools include the Ministry of Economics "Maatschappelijke Sectoren & ICT" action programme which has funded seven games projects, and the 'Make a Game'[32] annual national competition for pupils to design and build a computer game for use in schools.

Digital games are not specifically mentioned in the broad national educational goals, but schools are in any case completely autonomous in making financial, organisational and pedagogical decisions regarding the integration of ICT (including games) into the curriculum. Despite the recent national level incentives and ongoing support to integrate games into the curriculum they tend to be used only by innovative schools. Various communities of practice and online teaching material related to games based learning are available for teachers nationwide.

Now that digital games have been promoted and experimented in schools to a significant extent, the Netherlands seems set to move on to exploring how the positive educational aspects of gaming can be further exploited in the more complex area of virtual world environments.

The promotion of digital games at national level

Throughout 2006 and the beginning of 2007 there was a marked focus on using digital games (both commercial and educational) as learning tools in both primary and secondary schools, with the national ICT in education support organization, Kennisnet, taking an active role in research and pilot projects in this area. At that time using digital games for educational purposes was a hot topic in the Netherlands, with a significant amount of hype and money being invested in creating and promoting educational games in the public and private sectors, but with few measures undertaken to assess their impact until more recently.[33] There is now less of a national focus on games in education, as they are no longer such a novelty due to being better integrated into the education system. The Dutch Inspectorate for Education and Kennisnet list in their 2006 ICT country report for European Schoolnet, 'the successful use of gaming in education' as one of their key priorities.[34] In this same report it is stated that within the domain of formal learning the use of informal ICT applications such as games is increasingly encouraged as a learning tool.[35] At a more general level, the Dutch education system is reputed for being progressive in the uptake of new technologies and implementing their use within school practice. The underlying rationale for this is that traditional learning methods have become irrelevant and inaccessible to many of the young 'digital natives' in today's classrooms. Because school practices fail to echo their everyday experience in their lives outside school, many pupils have become demotivated and disaffected from learning. The Dutch education system therefore recognizes the need to make education more attractive by tapping into the highly motivating potential of new technologies, including games, as a way to re-engage learners. Using in the classroom digital games similar to those that young people play at home is seen as a effective way to make a meaningful connection between their personal and educational lives. Digital games, like ICT in general, are understood as a tool to support educational priorities, including reducing the high drop-out rate of young people from formal education and meeting the need to improve foreign language learning.

"Maatschappelijke Sectoren & ICT" (Society Sectors and ICT) is an action programme of the Dutch Ministry of Economics which launched a call for proposals to fund ICT-related projects starting at the end of 2006 and

finishing in 2009. 23 projects were funded from the education sector, and 7 of these were focused on digital games.[36] The criteria for receiving this state funding were to present a project that had already been piloted, had produced good results and had the potential for further development. The successful games projects also had to ensure the involvement of schools using games in collaboration with universities or libraries, with a clear intention to work in partnership with other schools to promote the project widely. The high number of games projects which satisfied these criteria is evidence of the education sector's interest in this area. It also demonstrates that the focus on recent years has not been to invest in new pilot projects on games in education, but rather to develop and scale up successful projects, with a view to extending their use at national level. More recently, towards the end of 2008, the Ministry for Education, Culture and Science[37] launched a call for proposals entitled 'Blended Content' to fund educational projects which mix the use of traditional and innovative learning methods. Projects involving digital games may well feature amongst the proposals. Since 2004, Kennisnet and SURFnet[38] have collaborated on the Innovation Programme,[39] which aims to facilitate ICT innovation at national level in primary through to higher education by working with schools and providing workshops for pupils and education professionals. Amongst their areas of activity are researching the educational value and use of digital learning materials, such as games; virtual environments, such as Second Life and Active Worlds; and mobile learning,[40] using PDA GPS, laptops and mobile phones for curriculum learning. Since 2006, Kennisnet has organized the ''Make a Game'' annual national competition, as a key activity of the Innovation Programme. The competition challenges teams of pupils to design and build a computer game that can be used in school. Most of the games are produced with *Game Maker*.[41] One team of pupils from each level of education is awarded a prize for producing the best computer game for learning.

School autonomy and the use of ICT and digital games as curriculum tools

Rather than a national curriculum, the Ministry of Education, Culture and Science sets out educational goals called ''*kerndoelen en eindtermen*''. It is up to each individual school to design a curriculum that meets these national educational goals. ICT is not understood as a discrete subject area, but rather as a learning tool to be used throughout the curriculum. It is mentioned within the national educational goals as a means to develop specific competences such as information processing and language skills. Digital games are not specifically mentioned in the broad national goals, but schools are in any case completely autonomous in making financial, organisational and pedagogical decisions regarding the integration of ICT (including games) into the curriculum. While the very decentralized and flexible nature of the Dutch education system means that schools have ample opportunity to engage in games-based learning, it also means that it is very difficult to know to what extent this takes place in practice. Despite the recent national level incentives (described above in section 1) and ongoing support to integrate games into the curriculum from the ICT and innovation in education organizations, Kennisnet and SURFnet, they tend to be used mainly by innovative schools with high ICT profiles which also enjoy support from senior management.

Kennisnet estimates that roughly 10 percent of all Dutch primary and secondary schools and 20 percent of vocational education institutions use digital games for learning. They are mostly used at secondary level, and most particularly in vocational education, where the subjects dealt with are most closely linked to those of many existing games (e.g. management games and business simulations). *Plaza Challenge*[42] is a Dutch economically oriented online management game produced by Game Basics[43] in 2005. The game's popularity and significant educational potential prompted the creation of the *Plaza School Edition*[44] in 2006. This educational version includes a special teacher module (for which schools have to pay a licence fee) allowing teachers to use the game in the classroom for secondary general and vocational education, at the correct level for their pupils. This version of the game has been specifically designed so that pupils receive formative feedback and teachers can track their progress. Kennisnet is aware of a number of schools which are using this game to develop competences such as creative thinking and taking responsible action, in accordance with the school curriculum and national goals. In addition to games being played in the

classroom to support the development of specific skills, schools are also invited to take a critical approach to them by teaching pupils to reflect on them as a cultural phenomenon. *Mediawijsheid*[45] (media wisdom) is a media knowledge centre which gives schools access to educational content concerning the critical appreciation of media, including games media. Similarly, 'medialessen.nl[46]' is a website that provides online teaching materials and lesson plans to develop media literacy skills in schools, including a recent category devoted to 'online games and virtual worlds'.

Communities of practice for teachers to share experiences and material related to using digital games in schools

Possibly as a result of their high level of autonomy, Dutch schools have traditionally worked in relative isolation. Concerned by this, the Dutch education system has over the past 15 years made efforts to connect schools more closely with other schools and the wider community in an attempt to foster mutual learning. ICT is seen as a way of facilitating this communication and collaboration. *Leraren24*[47] is an online community of practice initiated by the Ministry of Education, Culture and Science, allowing teachers nation wide to exchange experiences and didactic methods related to all educational issues, including the use of games. The Ministry is also currently developing *Wikiwijs* – an online space where teachers will be able to exchange digital educational content, with the aim of stimulating the use of ICT and enhancing professionalism. Kennisnet, who have a bottom-up approach in working closely with schools, are even more active in building online teacher communities, providing six for primary school teachers and 23 for secondary school teachers, each of which is dedicated to a specific educational concern. In the area of digital games, Kennisnet, in collaboration with SURFnet, launched an online community of practice called 'Games 2 Learn'[48] in 2006, when interest in this area was new and at its peak. The aim was to allow teachers, researchers, ICT in education expert and training centres, and industry to share their experiences about games and learning with the hope of spreading good practice in schools. The community of practice proved very popular and, although to a lesser extent, is still active today. The Games 2 Learn community is hosted by a wiki which supports interaction between all interested users, allowing them to contribute and share relevant material. The amount of information and material available is impressive. This includes: a comprehensive list of commercial and educational games[49] (description and direct link to the game itself where relevant) categorized by the type and level of education and the specific competences they are suited to develop; a calendar of relevant games in education events; tips on how to use games in schools; software to develop games from scratch; and research and articles related to games-based learning.

Future development

The seven games projects funded under the Ministry of Economics "Maatschappelijke Sectoren & ICT" action programme are in their last year of development. It is hoped that they will succeed in their aim to scale up the educational use of digital games in schools, so as to go some way in ensuring that games-based learning is not restricted to innovative schools but extended to the large majority. The positive results of various pilot projects regarding games in schools have given impetus to the Dutch research community[50] to further investigate their educational potential and impact on learning. In 2009 the Ministry of Education, Culture and Science is focusing on special needs education, both for the development of gifted pupils and those with learning difficulties. In response to this, Kennisnet is investigating the possibilities of using virtual gaming worlds to suit the special learning needs of gifted pupils. Now that digital games have been promoted and experimented in schools to a significant extent, the Netherlands seems set to move on to exploring how the positive educational aspects of gaming can be further exploited in the more complex area of virtual world environments.

Further information:

- See relevant publications and web links listed in the endnotes of this section.

Austria

In a nutshell…

Digital games are very rarely part of teaching in schools, except in some specific contexts such as language learning programmes targeted at recent migrant students. Public opinion and teachers are generally not in favour of using games in schools.

The Austrian education system is engaged in a major effort at reform, to develop innovations in schools and in particular to promote personalised learning. Within this framework, game-based learning could be developed rather more as an alternative to the 'teaching from the front' model. Some experiments are being conducted along these lines. In 2007, a team of schools specifically interested in testing the use of games in their teaching was set up.

In a attempt to benefit from the potential of digital games in terms of learning environment while protecting children from problematic content and behaviour, a public authority has been created to run a positive recommendation policy and try to educate parents and educators about the benefits as well as the dangers of computer and console games usage.

Central and regional public policy in ICT education concerning digital games

There are no central or regional guidelines regarding the use of digital games in education. Public opinion and teachers are generally not in favour of using games in schools. Many electronic platforms are now being developed for teachers to share digital material available in various schools. Games are very rarely mentioned on these platforms, and when they are, they are games in which the educational and learning component is very present and the 'fun' aspect almost absent. Digital games are nevertheless used in some specific contexts, such as language learning programmes targeted at recent migrant students, with a view to supporting their integration.

The Austrian education system is currently undergoing radical change at several levels, guided by the Ministry of Education. Fundamental reform of schooling is under way, with a very strong focus on quality and good management. This effort for change at many levels of the system and in many fields is supported by change-management training programmes for head teachers and school managers. This effort is concentrated for the moment on lower and upper secondary education and will be extended to primary education in the future.

Part of this impulse for change is a major initiative launched by the Ministry of Education to develop innovations in schools and in particular to promote personalised learning. Within this framework, game-based learning could be developed rather more, as an alternative to the 'teaching from the front' model. Some interest is being expressed in this direction by teachers and education policy makers at least to undertake experiments. Should these experiences prove successful, their application to the education system on a larger scale would remain difficult and challenging.

Within this national initiative to support personalisation of learning, around 200 schools have been designated as 'e-learning schools' and regarded as a group of innovators. Membership of this scheme means that schools receive specific funding from the ministry (3000 € for each school) which they are free to invest in accordance with their own needs and priorities (buying software, etc.). The cornerstone of the initiative is flexibility: each school is entitled to define the project that best suits its environment and specific challenges. Some of these schools have chosen to invest their grant in digital game-based learning and have formed into a team to work together.

A team of schools focusing on game-based learning

A team was set up in 2007, composed of 10 schools in various locations in Austria. The objective is to extend it to 20 schools during 2009, also covering lower secondary education. The team is specifically testing and experimenting with the use of games in their teaching. Within the group, upper secondary education (general education), vocational education and technological colleges are represented. Teachers participating in it use various types of games – entertainment and commercial games as well as others. The subjects concerned are languages, business studies, and games design for technical colleges. The team has put particular emphasis on the balance to be reached between personalisation and social cohesion. To this end, group work and individual work are combined and self-organised group sessions are planned. An evaluation of the activities developed at school level under the auspices of this team is planned to take place after three years (i.e. in 2011).

Personalisation of learning at school being the dominant paradigm, it is not expected that game-based learning will encounter problems as regards school time organisation or the constraints of the curriculum, which remains defined in terms of content. One of the two main obstacles is in fact the limited access to facilities (rooms locked, etc.). The progressive equipping of each student with a personal notebook computer, which started 5 years ago, is however improving this situation. The other obstacle is the limited availability of relevant good-quality games.

Teachers and digital games

As already mentioned, teachers are generally not very inclined to consider using digital games in the pedagogical process. Within the effort to reform the whole education system undertaken by the Ministry of Education, many events are being organised for the teachers interested: training with commitment of principals, permanent sessions, seminars, workshops, workgroups, etc. These are all part of the in-service training offer; but very few of them are concerned with the use of digital games in schools.

The situation is probably much the same in initial training for teachers. This training is provided at university level, and because the universities have autonomy in defining their programmes, it is very difficult to know if the use of games is addressed in some places. The first induction year implemented to help newly trained teachers to enter the reality of their profession could be a more adequate framework to integrate some issues regarding the use of games in schools, since this phase is directly managed by the school administration.

A specific rating policy for computer and console games

The dramatic rise in popularity of digital games amongst youngsters is a challenge to Austrian policy makers. They are seeking to find a way to protect children from problematic content and behaviour while nurturing the positive potential of computer games and digital media in general. This dilemma is difficult to resolve by using rigid regulations and legal bans on digital games that are judged undesirable, at a time when everybody has access to digital distribution channels outside governmental control.

The choice made has been to create a public authority applying a positive recommendation policy and also aiming to educate the public – focusing on parents as a priority – about the benefits as well as the risks of computer and console games usage. After two feasibility studies, the principle of a Federal Office for the Positive Rating of Computer and Console Games (BuPP) was agreed in late 2003 and was implemented under the auspices of the Austrian Federal Ministry of Health, Family and Youth. The BuPP became fully operational in late 2005, after several months of careful preparation. It drafts and disseminates a list of recommended games, as background information for parents and educators, and is published online and updated almost weekly.

The information provided by the BuPP indicates not only the age range appropriate for each game but more importantly its characteristics in terms of the cognitive skills addressed, the types of cooperation supported (team work), the quality of the graphics, etc. with a view to helping parents, teachers and youth workers to better understand the games used by youngsters and facilitating communication between all of them about the games used.

The day-to-day activities of the BuPP, which visits schools and teacher training education centres from time to time to present the initiative, reveal that some teachers are interested, particularly as regards History teaching. Others are motivated by a wish to better understand the reality in which their pupils and students live. Many teachers nevertheless keep their distance from digital games, or are even afraid of them; they do not see it as part of their mission to explain to their pupils the *what*, *why* and *how* of gaming. Educating pupils about the use of games would however need to be supported by specific training for teachers interested in moving in that direction. The BuPP is carrying out some induction activities to this end, using video together with guidance packages to explain to teachers how digital games function.

Further information:

- BuPP website:

  http://bupp.at/

Spain (Catalonia)

In a nutshell…

No official document mentions the use of electronic games in the classroom. The numerous portals designed for the various target groups within the educational community also make little reference to electronic games.

On the other hand, academic research is relatively well developed, including in the particular area of the use of electronic games in classroom teaching – and the role of the teacher in this is one of the focal points, as is the link with the curriculum.

Training initiatives and programmes do not appear to include the classroom use of electronic games. Nonetheless, a relatively large number of Catalan teachers declared an interest in the subject in the teachers' survey which is part of this European study.

The education authorities and the use of electronic games

The political and administrative division of Spain into Autonomous Communities with major responsibilities in education means that there are quite different specific situations in each of them.

Central government is responsible for general organisation of the education system, minimum requirements for schools, the minimum core curriculum, international cooperation in education, policies to encourage and coordinate research, general planning of education and regulation of academic and professional qualifications, the High Inspectorate, nationwide general diagnostic evaluations, policies on financial support for studies, etc.

The Autonomous Communities have administrative responsibility within their territories, and are responsible for the creation and authorization of institutions, staff management, curriculum development, student guidance and support, financial support and aids, Education Inspection, diagnostic evaluations in institutions, etc.

Local administrations are responsible for the provision of sites for building public institutions, maintenance and refurbishment of pre-primary and primary schools, planning extra-curricular and supplementary activities, monitoring compulsory schooling, etc.

Schools are autonomous in organisational, educational and financial matters, within the framework of current regulations.

The Community chosen for this study, for an overview of the classroom use of electronic games, is Catalonia.

As in several European countries, the education authorities in Catalonia have not formulated particular recommendations either for or against the use of electronic games in the classroom. In general, the political decision-makers are open-minded and potentially interested in the question, while being aware of the reluctance encountered in some areas of public opinion. It is clear in any case that no specific measures have been taken to encourage it. The limited salience of electronic games on the educational portals is evidence of this.

Catalonia has made a particular effort to develop its educational portals. XTEC (http://www.xtec.cat) is a portal for teachers' and schools' educational use of ICT. It offers email services and web space for teachers and schools, access to administrative networks and other features. Edu3 (http://www.edu3.cat) is an audiovisual portal open to the educational community, which provides free online access to audiovisual

material from the public Catalan Media Corporation (CCMA) and the Department of Education; edu365 (http://www.edu365.cat) is a portal developed to promote educational use of ICT by students and families; and Clic (http://clic.xtec.cat) is a portal for a community of teachers creating content. Clic offers a set of free software for the development of multimedia educational activities. The clicZone is a public service provided by the Ministry of Education of the Government of Catalonia to spread and support the use of these resources, and to serve as an area of cooperation open to all educators who want to share the applications produced using the programmes. The first two portals make no reference to electronic games for the classroom; Clic offers a few puzzles.

Academic research on electronic games

Researchers at the Universitat Oberta de Catalunya (the Open University of Catalonia) are active in research on learning through electronic games. One project, for example, has been carried out with a university in Chile on the use of strategy games as vehicles for the school curriculum. A multidisciplinary team of academics and teachers carried out an initiative to design and implement an educational sequence which, by including the use of the strategy game Age of Empires into the teaching, would be able to serve as a vehicle for curricular learning in the social sciences and mathematics. The work of the class of 78 pupils at level K7 who used these games focused on three areas: remediation, implementation or application, and evaluation.

Other Spanish universities, outside Catalonia, are also active in this field. One example is the University of Alcala in Madrid, where work is being done particularly on the use of commercial games in educational contexts. The main aim is to design digital materials capable of supporting teachers' and families' use of games and to bring to light the rules that organise their structure, codes and symbolic universe.

Teacher training and electronic games in the classroom

In initial teacher training, ICT is not regarded as a common or main curriculum subject. Basic training in ICT is an optional subject in some initial teacher training courses. In teachers' continuous professional development through the Department of Education, ICT was made one of the top five priorities in the Overall Plan 2005-10. In other training priorities (inclusive school, curriculum, personal and professional development and schools' organization) ICT training should be embedded. Neither initial nor ongoing teacher training initiatives and programmes make reference to classroom use of video games.

The fundamental and priority goal is that teachers use their ICT knowledge in curricular subjects in such a way that ICT technologies contribute to learning and understanding processes. Several studies reveal that teachers are not using ICT to teach in the classroom, but only to prepare their lessons and materials. Change is overdue and teachers' professional development could be the right tool to help in this direction. This approach might eventually develop more interest in electronic games on the part of Catalan teachers, a particularly large number of whom took part in the online survey for this study.

Prospects and challenges

The Catalan education authorities have a strong interest, *inter alia*, in the personalization of educational processes. Increased school autonomy is another tendency underlying various reform initiatives. The curriculum places strong emphasis on key skills and defines its objectives in terms of skills rather than content. The eight basic skills are: linguistic and audiovisual communicative competence, artistic and cultural competence, information processing and digital competence, mathematical competence, competence in learning how to learn, competence in autonomy and personal initiative, competence in knowledge of and interaction with the physical world, social and civic competence.

As in other education systems, these tendencies have the potential to open the doors to the use of electronic games in educational processes. This is because they lend themselves well to the implementation of greater personalization and the learning of key skills. Greater school autonomy could also mean that some schools or teachers, for specific contextual reasons, will try out experiments in this area. Greater interest in the use of electronic games in the classroom is a further possible, if not guaranteed, consequence.

Further information:

- F9: Research group of teachers interested in the use of videogames in the classroom:

  http://www.xtec.net/~abernat/welcome.htm

- Blog about the use of "Thinking Worlds", A 3D application to create animations and interactive units":

  http://blocs.xtec.cat/thinkingworlds

- Play and Learn. New page at edu365 devoted to the description of commercial videogames which contain elements that can be used in the classroom (in progress of creation):

  http://www.edu365.cat/jocs/index.htm

Lithuania

In a nutshell…

Digital games are very rarely used in Lithuanian classrooms, and there is still a significant lack of quality educational digital tools and content available. However, by moving away from a focus on content to skills, and by putting a clear emphasis on the differentiation and individualisation of learning, the new curriculum published in 2008 is now more conducive to their integration. Although the use of ICT in primary schools is not compulsory, the National Curriculum specifically recommends using educational software and educational games for primary school teaching.

Despite teachers' freedom to experiment, research indicates that the large majority of Lithuanian teachers continue to use traditional rather than innovative pedagogical methods. Whether or not the limited games-related pilot projects that have taken place or are planned will encourage the emergence of digital games in Lithuanian learning resource repositories and as the subject of teacher online forums remains to be seen.

National ICT priorities and the potential place of digital games

The development of ICT in Lithuania, although still considered a priority by the Ministry of Education and Science,[51] has been superseded by an increasing emphasis on higher education reform. This is reflected in the Ministry's new 2009 work programme to implement the 2008-2012 ICT in Education Strategy, which instead of last year's 20 separate goals, all of which were allocated a specific budget, has only four overarching goals, to which limited resources are assigned. The four main goals of the 2008-2012 ICT in education strategy are:

- The development of ICT infrastructure in schools, to improve the personal learning environments of teachers and students
- The development of school collaboration and teachers' ICT competences
- The development of management software for schools
- The development of digital content and services for schools

The use of digital games in schools is considered to fall under the scope of the fourth goal, which specifies the need to develop digital content and create educational software with a high interactive element, for learning and assessment purposes. There is still a significant lack of quality educational digital tools and content in Lithuania, despite the special strategy[52] that was put in place to develop this, with implementation proving to be slow and ineffective. The strategy emphasizes the need to develop computer teaching aids, or 'learning objects'. A learning object is defined as any digital resource that can be re-used to support learning. In order for digital games (as well as all other educational software purchased for schools with the state budget) to qualify as valid learning objects that can be used to support curriculum teaching, they must be approved by a special IT expert group which acts under the auspices of the Centre of Information Technologies of Education[53] (CITE, a governmental organization funded by the Ministry of Education and Science). Amongst the evaluation criteria are high educational value and good communication and collaboration possibilities.

ICT and digital games in the curriculum

In November 2006, a Strategy for the Development, Implementation, Assessment and Renewal of the Content of General Education for 2006-2012 was adopted. The Strategy provides for the upgrade of the curriculum on the basis of the development of key competencies.[54] This ongoing educational reform shifts curricular content and teaching methods towards interdisciplinary and multidisciplinary learning and the development of higher-level skills (e.g. problem solving and communication).[55] By moving away from a focus on content to skills, and by putting a clear emphasis on the differentiation and individualisation of learning, the new curriculum, published in 2008, is now more conducive to the use of digital games in the classroom. The use of ICT in the primary school curriculum is optional. The National Curriculum does however recommend the integration of ICT skill development into the overall learning process, and specifically the use of educational software and educational games in primary school teaching.[56] The Strategy for the Introduction of ICT into Lithuanian Education for 2005-2007 mentions that primary and secondary schools should consider the use of promising mobile technologies in organizing and delivering the curriculum.[57] At secondary level, Information Technology (Informatics) is taught as a separate subject and is mandatory from the age of 11 until the end of compulsory schooling. Teachers are free to integrate the use of ICT into other subjects and in cross-curricular learning, but the National Curriculum does not officially prescribe this.

In line with the new focus on giving schools more possibilities to personalize teaching and learning in accordance with pupils' abilities and interests, pupils aged 15/16 can take optional modules to specialize in certain subjects, such as ICT. The optional modules offered by a school depend on its particular profile, the expertise of the teaching staff, and students' interests. ICT optional modules may include for example, computer programming, film design, electronic publishing and media literacy. Teachers are free to develop their own optional modules, covering content not specified in the National Curriculum, providing it is approved by the head teacher. In this flexible framework, teachers are free to propose digital games as the subject of an optional module (e.g. the learning of game design, or the critical appreciation of computer games in the context of media literacy), or use them as a tool through which to implement the official National Curriculum. Although there are official teacher guidelines for the implementation of the national curriculum, teachers have a significant amount of freedom to experiment with new methods. Despite such freedom for experimentation, research indicates that the large majority of Lithuanian teachers continue to use traditional rather than innovative pedagogical methods.

A national study on the use of computer teaching aids (including educational software and digital learning objects) in the pedagogical process was recently commissioned by the Ministry of Education and Science and published in December 2008.[58] It found that roughly 50 percent of teachers at both primary and secondary level use computer teaching aids, which may include digital games. The Ministry of Education and Science and the Institute of Mathematics and Informatics have also recently initiated several research projects on the implementation of educational software in schools. The surveys carried out as part of these research projects show that 60 percent of teachers think digital learning objects increase students' knowledge, 70 percent think they increase students' skills, and 80 percent state that they increase students' motivation. However, despite teachers' claims and enthusiasm, these research projects conclude that most of the ICT tools they use are rather basic and restricted to functional activities, such as presenting project work using PowerPoint, rather than exploiting dynamic, interactive learning possibilities.

Teachers' use of digital games

Schools are free to use their own budget to purchase digital games, should they so choose. In the very rare cases where digital games are used in the classroom, teachers tend mostly to use simulation games to teach primarily economics, but also physics and ICT at secondary level. Junior Achievement is an American organization that produces commercial games about economics. Some schools choose to use the English version of these games for the additional language learning value, while others take advantage of the fact that many of these games have been translated into Lithuanian. An example of a popular game by Junior

Achievement is *Supply and Demand: the JA Market Game*, which uses an experiential game format to help students actively learn the concept of supply and demand and understand how market forces affect the price of products. An example of an educational game known to be used by some exceptional primary schools is the Lithuanian game *Saltinėlis*.[59] Worthy of note is the eMapps project,[60] funded under the European Commission's FP6 IST Call 4 Priority 2.4.13: 'Strengthening the Integration of the ICT research effort in an Enlarged Europe', in which two Lithuanian schools[61] took part. The project focused on innovative ways of learning, using computer games and mobile learning with pupils in the 9-12 age range.

Prospects and challenges

The central repository for valid and recommended educational content and software as well as experimental content for testing, is *e-Mokykla*[62] (e-School). Digital content is systematized according to its type (e.g. type of software), relevance to curriculum subjects, target audience (teachers, pupils or parents), availability (free or commercial) and publisher. Online forums for teachers to discuss and share new digital material also exist.[63] Digital games do not presently feature significantly in Lithuanian learning resource repositories[64] or as the subject of teacher online forums. It remains to be seen whether the situation will change in the future. With the introduction of a new curriculum based on the development of competences and personalized learning, the outlook seems positive. The official, governmental organization for ICT in education, CITE, is not currently engaged in any research or development work in the area of digital games in education. Its interests lie rather in innovative projects aimed at the implementation of collaborative virtual learning environments, to provide distance learning courses for gifted pupils and those with special educational needs.[65] However, the Institute of Mobile Technologies for Education and Culture[66] (IMOTEC) has been a partner in various international games-based learning projects since 2000, and is currently planning a proposal to develop a project under the ICT strand of the European Union's Lifelong Learning Programme, focused on using interactive technologies such as digital games to make creative connections between the EU key competences[67] and the Lithuanian curriculum.

Further information:

- See relevant publications and web links listed in the endnotes of this section.

Endnotes

[1] M. Csikszentmihalyi, *Flow: The Psychology of Optimal Experience*, New York: HarperCollins, 1990, p . 71.
[2] Safer Children in a Digital World: The Report of the Byron Review (March, 2008). Available at: http://www.dcsf.gov.uk/byronreview/pdfs/Final%20Report%20Bookmarked.pdf
[3] See: http://www.dcsf.gov.uk
[4] See: http://www.dcms.gov.uk
[5] The nuances of games include: differences in content, context, play length, realism, repetition and interaction (Byron Review, p. 159).
[6] See: http://www.dius.gov.uk
[7] Innovation Nation White Paper (March 2008). Available at: http://www.dius.gov.uk/innovation/innovation_nation/annual_innovation_report.aspx
[8] Leitch Review of Skills, Prosperity for all in the global economy - world class skills (5th December 2006). Available at: http://www.hm-treasury.gov.uk/leitch_review_index.htm
[9] See: http://www.qca.org.uk/
[10] See: http://www.qca.org.uk/qca_10327.aspx
[11] The government has promoted this policy to ensure that each child, whatever their background or circumstances, has the support he/she needs to be healthy, stay safe, enjoy and achieve, make a positive contribution and achieve economic well-being. See: http://www.everychildmatters.gov.uk/
[12] Byron Review, pp. 188
[13] Extending Opportunity, Final Report of the Minister's Taskforce on Home Access to Technology (July 2008). Available at: http://schools.becta.org.uk/upload-dir/downloads/page_documents/partners/home_access_report.pdf
[14] See: http://www.parentscentre.gov.uk/
[15] It can be delivered either by discrete ICT lessons, cross-curricular teaching or a combination of both.
[16] See Section 7: What do we know from research about the use of games in education?, in this report.
[17] See: http://www.thersa.org/about-us
[18] See : http://www.thersa.org/projects/education/opening-minds
[19] The five key competence areas of the Opening Minds Framework are: learning, citizenship, relating to people, managing situations, and managing information.
[20] Key stages 3 and 4 cover the 11-16 age range.
[21] See: http://curriculum.qca.org.uk/key-stages-3-and-4/developing-your-curriculum/what_has_changed_and_why/index.aspx
[22] See: http://www.ltscotland.org.uk/curriculumforexcellence/index.asp
[23] In addition to the three capacities listed in the English National Curriculum, the Scottish Curriculum for Excellence identifies a fourth capacity to enable all young people to become 'effective contributors'. See: http://www.ltscotland.org.uk/curriculumforexcellence/curriculumoverview/aims/fourcapacities.asp
[24] Learning and Teaching Scotland (LTS) is a public body sponsored by the Schools Directorate, which is one of the Scottish Government's Education and Lifelong Learning Directorates. See: http://www.ltscotland.org.uk/
[25] See: http://www.ltscotland.org.uk/ictineducation/gamesbasedlearning/aboutgbl/gamesandcfe.asp
[26] See: http://www.ltscotland.org.uk/glowscotland/index.asp
[27] See: http://www.ltscotland.org.uk/Images/technologies_experiences_outcomes_tcm4-539894.pdf
[28] Becta is the government agency leading the national drive to ensure the effective and innovative use of technology throughout learning. See: http://www.becta.org.uk/
[29] Becta (2007) *Emerging Technologies for Learning: volume 2 – Computer Games in Education*. Available from: http://partners.becta.org.uk/index.php?section=rh&rid=13768
[30] For example, Futurelab (a non-profit organisation that develops resources and practices based on development and research activities to support new approaches to learning through technology and innovation - http://www.futurelab.org.uk/) produced a study on the potential of using commercial computer games in formal education with an accompanying guidance for educators in 2007. See: http://www.futurelab.org.uk/projects/teaching-with-games.
[31] Kennisnet is a public organization that supports the implementation of ICT in education in the Netherlands. Kennisnet aims at national and regional cooperation with schools, branch organizations and (municipal-)governments to provide tailor-made ICT support for primary, secondary and vocational education. See: http://corporate.kennisnet.nl/international

[32] See: http://www.surfnetkennisnetproject.nl/resultaten/mag (Dutch) and http://www.surfnetkennisnetproject.nl/internationalvisitors/resultssofar (English)
[33] For further information regarding research undertaken to assess the learning impact of a Dutch games pilot project 'Frequency 1550', see section 4 of this report.
[34] Insight Country Report for the Netherlands, European Schoolnet (October 2006), p. 4. Available at: http://insight.eun.org/ww/en/pub/insight/misc/country_report.cfm?
[35] Insight Country Report for the Netherlands, European Schoolnet (October 2006), p. 5. Available at: http://insight.eun.org/ww/en/pub/insight/misc/country_report.cfm?
[36] For a list of all the education projects funded under this call for proposals from the Ministry of Economics see: http://www.m-ict.nl/index.php?option=com_content&task=category&sectionid=27&id=55&Itemid=212. One of the projects funded was *The Games Atelier*, which is described in detail in section 4 of this report.
[37] See: http://www.minocw.nl/english/index.html
[38] SURFnet is a subsidiary of the SURF organisation, in which Dutch universities, universities for applied sciences and research centres collaborate nationally and internationally on innovative ICT projects. See: http://www.surfnet.nl/en/Pages/default.aspx
[39] See: http://www.surfnetkennisnetproject.nl/internationalvisitors
[40] Waag Society (www.waag.nl) in particular is recognized as taking the lead in promoting mobile learning in the Netherlands. See section 4 of this report.
[41] See: http://en.wikipedia.org/wiki/Game_Maker
[42] http://www.plazachallenge.nl/plazainternational.asp
[43] http://www.gamebasics.co.uk/index.asp
[44] http://www.plazaschool.nl/?ref=gamebasics (Dutch)
[45] See: http://www.mediawijsheid.nl/
[46] http://medialessen.nl/
[47] See: http://www.leraar24.nl/
[48] See: http://www.games2learn.nl/Hoofdpagina
[49] See: http://www.games2learn.nl/Categorie:Games
[50] Researchers at the Universities of Delft and Utrecht in particular are currently engaged in research on games and learning in schools.
[51] See: http://www.smm.lt/en/
[52] The 'Strategy of Schools Provision with Computer Teaching Aids' was launched in 2002, and re-launched in 2005. See: Insight Country Report for Lithuania, European Schoolnet, (March 2008), p. 7. Available at: http://insight.eun.org/ww/en/pub/insight/misc/country_report.cfm
[53] See: http://www.ipc.lt/english.htm
[54] National summary sheet on the Lithuanian education system, Eurydice, (2009). Available at: http://eacea.ec.europa.eu/ressources/eurydice/pdf/047DN/047_LT_EN.pdf
[55] eMapps Report on Lithuania, European Schoolnet, (2007), p. 6. Available at: http://emapps.info/eng/Results/Lithuania
[56] Insight Country Report for Lithuania, European Schoolnet, *op. cit.,* p. 4.
[57] eMapps Report on Lithuania, European Schoolnet, *op. cit.* p. 8.
[58] Institute of Mathematics and Informatics, (2008), Analysis of Existing Computer Teaching Aids, Scientific Research Report. Available at: http://www.emokykla.lt/lt.php/tyrimai/194
[59] eMapps Report on Lithuania, European Schoolnet, *op. cit.*, p. 11. For information (in Lithuanian) on the game see: http://www.emokykla.lt/lt.php/mokykloms_perduota_iranga/technines_irangos_skirstymas/151
[60] See: http://emapps.info/eng
[61] For information on the participating schools see: http://emapps.info/eng/Schools-Portfolio/LT1-Gabijos-School-Klaipeda-Lithuania
[62] See: http://www.emokykla.lt/lt.php/istekliai/117?new_search=1 and http://mkp.emokykla.lt/
[63] See: http://portalas.emokykla.lt/Puslapiai/Forumas.aspx
[64] For a full list of Lithuanian learning resource repositories see: eMapps Report on Lithuania, European Schoolnet, *op. cit.* pp. 12-14.
[65] Insight Country Report for Lithuania, European Schoolnet, *op. cit.* p. 5.
[66] See: http://www.imotec.lt/index.php?id=1&L=1
[67] See: http://ec.europa.eu/education/policies/2010/doc/keyrec_en.pdf

What do we know from research about the use of games in education?

Maja Pivec and Paul Pivec

7. What do we know from research about the use of games in education?

Summary

Purpose of this literature review

This literature review analyses the use of video games as a educational tool, drawing upon existing research, with the aim of identifying how to build up young people's key competence of digital literacy (more critical and responsible in their video games use) and identifies the state of educational gaming in schools.

Examples of games utilised are highlighted from the literature and frameworks for using Game-Based Learning (GBL) are discussed.

Key findings

Skills, knowledge and attitudes can be improved by means of Game-Based Learning (GBL), given the right environment. Research into using games for learning to support these claims has been carried out over the past 20 years, but with very mixed results. However, the choice of game along with the environment in which it is situated and the teacher's role as moderator are vital if the desired learning outcomes are to be achieved. Video games can supplement traditional learning but not replace it. But whereas the majority of today's teachers are willing to incorporate GBL into their lesson plans, the knowledge and level of skill required to implement this technology successfully are lacking. For GBL to be included in the academic curriculum, the issue of teacher support needs to be addressed on a wide scale.

Over the past decade, teachers' attitudes towards the utilization of games for learning have changed. Whereas historically games were not seen to be of value, academic institutions worldwide are now looking towards this technology to advance learning. Unfortunately, many of today's students do not see the value of game-based learning. The younger student will enjoy the interaction without categorizing it as learning and the older student will often view games as a non-serious activity within the classroom.

Summarised results from examples

Where the computer game is used in the classroom for research, it will often be an educational game specifically developed for the purpose, and often by the researcher. Where a game is utilized as part of a lesson, it will tend to be a commercial-off-the-shelf (COTS) game, often a recreational game or a commercial game that has been modified for the desired learning outcome.

Students today are critical of educational games because the quality expected of a commercial recreational game is missing. Modifying commercial games has become popular to avoid this, as has allowing students to design their own game – either to concept level or to a prototype if resources allow.

As games can extend outside the classroom, they provide an ideal platform for study aids and to assist with learning impairments. The medical profession has been quicker in the uptake of this technology than has academia, and examples are documented in this review.

Issues for using game-based learning

Although video games have been around for nearly 40 years, and GBL has been researched for over 20 years, the uptake of this technology in the classroom has been slow. The major barrier has been and still is a lack of knowledge in how to use the resource. Teachers are trained in traditional methods that do not include the use of games in the curriculum. It appears to be researchers and a few innovative teachers that have successfully embraced GBL, although many others are willing to do so, given adequate resources and assistance.

Studies show that unless the correct game is chosen for the selected topic, and appropriate moderation and debriefing by the teacher is forthcoming, the desired learning outcome, be it skill-based, knowledge-based or affective, will not be achieved.

Other issues for consideration include technical requirements, licensing policies, sustainability, and more. Video games are an untapped resource in the field of education and will remain so until adequate teacher resources are provided.

Details of this review

This review summarizes the available literature in the field of game-based learning and specifically how it relates to teaching in the classroom. A critical analysis of some of these studies is also provided in section 1, including a summary of the methodologies employed. Section 1 also discusses the benefits and perceived problems associated with video games, with section 2 providing specific examples of the use of game-based learning within the curriculum.

To conclude, section 3 analyses the characteristics of video games and suggests how this method of teaching can support the learning process. A complete reference section is included as well as a glossary of game terminology and some suggested resources.

Introduction

In 2006 one of the biggest European e-learning conferences, Online Educa Berlin, introduced a special game track. The two-day session hosted an open discussion between academics, teachers and industry practitioners, focusing on the potential of game-based learning in Universities and lifelong learning institutions and possible software solutions. The discussions were primarily focused on the Pros and Cons of the application of games for learning, trying to find answers to "*Why don't we use games more often in classrooms?"*

Several speakers pointed to the difficulty of finding games that cover the curricular topics and the low tolerance of the environment towards games, where games are often perceived as unserious activity, with some fearing that the learning objectives would not be reached, while others saw difficulties arising from schools' lack of technical resources. In 2007, the games track remained one of the most popular at the Online Educa. It was noted that games for learning are gaining increasing publicity and that they are increasingly perceived also as a learning resource.

"Research into using games for learning has been carried out over the past 20 years, but with very mixed results."

Educators and researchers have long been suggesting that video games have the potential to enhance learning (Malone, 1981; Ramsberger et al., 1983; Malone & Lepper, 1987; Donchin, 1989; Thomas & Macredie, 1994; Ruben, 1999). Many state that the characteristics of some video games create an immersive environment, focusing the player's attention and potentially increasing the uptake of knowledge (MacMahan, 2003; Paras & Bizzocchi, 2005; Gentile, 2005; Kearney, 2006). What is generally accepted is that video games can provide the motivation necessary to invoke a persistent re-engagement by the player, thereby improving the chances of the desired learning outcomes (Garris, Ahlers, & Driskell, 2002; Kearney & Pivec, 2007a).

Several major reports that have been commissioned on the topic of educational games (Entertainment and Leisure Software Publishers Association, 2006; Federation of American Scientists, 2006; Facer, Ulicsak, & Sandford, 2007; Project Tomorrow, 2008) have suggested that video games teach skills that relate to education and that these skills transfer to business They call for educational institutions to embrace the games community.

> ***"Revamp old pedagogy to take advantage of these new educational tools"*** *Federation of American Scientists, 2006, p.10*

These reports cite publications such as Menn (1993), who argues that only 50% of what is watched is learned, but 90% of what is experienced is mastered, and Prensky (2006), who suggests that students will soon be teaching themselves. Levy and Murnane (2004) suggest that although schools focus on topics such as maths and literacy, soft skills like communication, collaboration and problem solving are not taught and that these are skills that industry requires. Klopfer (2008) advocates education games as a method for teaching soft skills by allowing the students to experience learning through role-play and games. This teaching methodology is known as constructivism, and Game-Based Learning is situated in the constructivist arena. Research into using games for learning to support these claims has been carried out over the past 20 years, but with very mixed results.

Related studies and literature on video games as an educational tool

Research into Game-Based Learning (GBL) as an educational resource has been available since the 1980s. Many believe that GBL provides benefits for most teaching applications, given the appropriate funding and acceptance. The Entertainment and Leisure Software Publishers Association (2006) suggest that this belief has grown from the desire to make learning fun and the opinion that video games are "a powerful learning tool" (p.14). Much of this belief has been spawned from the notion that today's students are "Digital Natives", having grown up in a digital world. This concept has been attributed to Marc Prensky, one of the most widely cited authors in digital game-based learning (Prensky, 2001b), yet many suggest that not only are Prensky's theories severely flawed, but the term Digital Natives was in use prior to his publications (McKenzie, 2007; Siemens, 2007; Bennett, Maton, & Kervin, 2008). In fact, after a thorough analysis of the majority of Prensky's publications, it is considered that they are mainly opinion papers, not peer-reviewed studies, and offer very little empirical research to support the claims.

Several literature resources support the application of technology as a learning tool and also game-based learning, yet refute the belief that this is because children grow up in a digital world as suggested by Prensky (2001a), Gee (2003), Squire (2004), Shaffer (2006), and others. Take for an example the "Hole in the wall" project (Mitra & Rana, 2001). Computers were set up across India in locations that had never seen any type of technology before. No training or tuition of any type was provided, yet these children were surfing the Internet within hours, downloading movies, using drawing software, playing video games, and even taught themselves how to cut, paste, and save their files. They collaborated with each other and worked in groups, they formed social groupings, and became highly motivated to continue to use this newly introduced technology, all without supervision – all of the attributes Prensky and others suggest are only present in children that he calls digital natives.

Mitgutsch (2007) argues that it is neither the computer game nor the technology that promotes learning, but the play surrounding it. He also rejects the term Digital Game-Based Learning in favour of Digital Play-Based Learning. He suggests that learning occurs in a non-linear unstructured way when technology or video games are used as a teaching tool, and it is often the environment that fosters the uptake of knowledge and understanding. Although the salient points in his publication appear valid, for the purpose of this review the term Game-Based Learning (GBL) will be used, referring to application of digital games for learning as well as role play.

> "The desire to make learning fun and the opinion that video games are a powerful learning tool."

The following sections of this literature review summarize the major peer-reviewed studies published in the field of Video Games for Education and relate them to Game-Based Learning. A balanced view has been attempted, however many publications appear to be biased towards video games and methodologies employed are often less than rigorous (Egenfeldt-Nielsen, 2007). Many studies did not use a control group nor did they compare other forms of teaching and learning as alternatives. It is also difficult to assess whether the employment of the computer game has assisted in the learning process or whether was just that the students embraced the technology, as found in the Mitra and Rana studies (2001).

Instructional design and learning from video games

Ko (2002) explored a framework for studying the patterns children follow to solve puzzles in a computer game. Using a memory puzzle game called *Find the Flamingo,* Ko enlisted 32 children aged seven, and 55 children aged ten. He measured the children's technique for problem-solving by counting moves and assessing the pattern of these moves. He did this using a board version of the game as well as a computer

version. Among the findings, Ko notes that the children appeared more motivated to use technology and play the computer version rather than the board version. Ko also noted that the more times the children played the game, the greater their understanding of the construction of the game and the inferences within the game-play. The group of ten-year-olds performed better overall than the seven-year-olds in the results, with the ten-year-olds requiring fewer moves to complete the game. Ko concluded that this study shows that children can solve problems by gaining inferences from the game itself, and, by using these hints, apply reasoned decision-making to increase their performance. But does the design of the game influence the child's playing behaviour? Ko says "Yes", and suggests that educators must consider this when choosing games as part of a learning curriculum.

Curtis and Lawson (2002) wanted to ascertain if problem-solving performance could be improved by playing video games, rather than the game just influencing how the player's ability is used. They note that there are two theories as to how problems are resolved: using gained knowledge or using strategy. They developed an adventure game called *The Ancient Abbey,* where the player is required to search for objects in various locations. Recruiting 40 participants between the ages of 12 and 15, the researchers recorded and transcribed the player's verbal commentary during the game. The players' paths through the locations within the game were also recorded and later examined using PLS path analysis (Partial Least Squares – a method for developing a predictive model). Curtis and Lawson's results were inconclusive. While their statistical analysis showed that the players developed strategies and applied these in problem solving, there was no evidence to show that this skill would carry over to tasks outside of this game; they did not show that cognitive ability was increased except within the confines of this game. However, they did find that increasing the complexity of the game increased the cognitive load on the player, but when the player developed knowledge based on the game, this load was reduced.

"The design of the game influences the child's playing behaviour and educators must consider this when choosing games as part of a learning curriculum."

Pillay (2003) conducted a similar study with 36 students between the ages of 14 and 16. He maintained that although their knowledge was significant, an analysis of the strategy process and how it affects performance was needed. The participants were divided into groups and each group was given either educational puzzle games or recreational strategy games. He used a mixed-method design adopting both a quasi-experimental design and an adaptation of the PARI analysis (Precursor, Action, Result, and Interpretations). Pillay found that the recreational games facilitated learning more than the educational ones. He suggested that the game players reasoned more effectively and employed anticipatory thinking. He reinforced Ko's (2002) findings, suggesting that the students were able to learn by gaining inferences from the games design.

Egenfeldt-Nielsen (2005) explored the framework in which video games could be used within a classroom environment. His research involved the participation of 72 high school students and their teachers over a period of 10 weeks. Using a commercial historical strategy game, *"Europa Universalis II"*, his results suggested a difficulty in relating the lessons learned within the game to the desired learning outcomes and concludes with a suggested framework for overcoming these issues. Suggestions such as using games to build on existing knowledge or experimenting within a safe virtual environment point to video games being used in addition to traditional lessons and not as a replacement.

"Young people often perceive the use of games for education as an un-serious activity..."

Zagal, Rick and Hsi (2006) also used board games in their research and concluded by comparing the collaborative design of *"The Lord of the Rings"* with popular multiplayer video games such as *"Battlefield 1942"*. They concluded that although games that foster collaboration between the players

are difficult to design, they provide a unique potential to foster such activities as teamwork, collaborative problem solving and decision-making, and responsibilities within the group. They go further to state that video games are uniquely positioned to overcome some of the pitfalls of board games by utilizing well defined instructional design and communication support features. Moreover, with some unstructured online multiplayer games providing such player freedom, they suggested that players are forced to collaborate and create their own rules to progress through the game.

Pannese and Carlesi (2007) looked at games within the classroom environment and compared the use of games for training within Universities and Industry. They observed that while computer technology provides a valuable resource and, if structured correctly, a computer game will immerse the participant in the learning, younger people are more critical about the use of games and the game itself. With many students being exposed to commercial games every day – and the PISA (2006) survey of OECD countries states that almost all 15 year old students are comfortable with using this technology – young people often perceive the use of games for education as an un-serious activity, as shown in a survey of 160 university students by Pivec and Kearney (2007).

Kovalik and Kovalik (2008) studied player collaboration within simple games and found that lessons of everyday life could be learned. In their study they divided participants into groups to play card games with rules, without rules, and with non-specific rules. Their results suggested that the students were willing to accept the rules of the games and, where there were none, they imposed their own. During the debriefing with the students, they discussed similarities between the rules of society and rules within a game. They found that their students were subsequently willing to accept the need for rules within an organized society, since, without these rules, chaos can ensue as it did in the games without any rules or with non-specific ones.

Perceived effects of playing video games

With much of the literature having opposing views as to which attributes educational and commercial game designers should focus on, critics often turn to discussing what effect these games have on the children playing them. Subrahmanyam, Kraut, Greenfield and Gross (2000) discuss the literature available regarding the impact of computers and video games on a child's development, but state that the findings of these studies are only suggestive with very little empirical data being offered. The studies they include range from very small sample sizes to over 500 participants. They cite several papers that suggest links between inactivity, playing video games and child obesity, and promote the view that first-person shooter games lead to aggressive behaviour. They also discuss the question of increased academic performance through playing games and argue that there is no systematic research or empirical studies to support any firm conclusion.

However, Stevens (2000) studied 33 students ranging in age from seven to 14. These students played games for one hour each morning, on 30 occasions. The researchers also used a control group of 37 students who completed the same tests without playing the games; however, no alternative teaching method such as drill and practice was offered. Stevens notes that parents of the participants who played the games not only reported improvements in school work, but also in other skills such as the sense of direction, increased interest in literature, and increased patience with daily tasks. This suggests that Dorval and Pepin (1986) were correct and that video games can improve visual and spatial skills, resulting in higher academic performance.

In a qualitative study of 500 children in New Zealand between the ages of five and ten, Wylie (2001) found that television impacted adversely on children's reading whereas computers games did not. She also observed that children's visual skills were increased by playing video games and maintains that no adverse social effects are seen when playing moderate amounts of games, but notes that other researchers claim that aggression is linked to excessive playing time, i.e. more than thirty hours per week.

In a study completed by Attewell, Suazo-Garcia and Battle (2003) with 1,680 school children in the UK between the ages of four and 13, some tangible results were offered. They included social aspects, such as self-esteem and obesity, as well as performance factors like abilities in academic competence. The results of their study showed that children who used computers not only scored significantly higher on cognitive tests, but also spent more time reading books than those who did not use a computer. However, they do address the difficult question of whether or not children who read more and have higher cognitive abilities are naturally attracted to computers. Attewell et al. noted that computer users also scored higher in the self-esteem tests, but this was only for children who used a computer for less than eight hours per week. Children who used a computer for more than eight hours tended to suffer from obesity and had low self-esteem, possibly as a result of the weight problem. Interestingly, they also found that television had a detrimental effect on outdoor activities, whereas computer usage did not, thus supporting the finding of Wylie (2001). Attewell et al. concluded that modest use of computers by children was significantly beneficial, both socially and academically. They highlighted that the majority of the children's computer usage was for playing video games.

"No adverse social effects are seen when playing moderate amounts of games."

"Sex and violence in videogames are a social issue that confronts us all, yet as a society we are inconsistent."

Kearney (2005) found that the playing of recreational games, such as the first-person shooter (FPS) *"Counter Strike*", for up to eight hours per week increased multi-tasking abilities. Kearney's research showed that those who played for up to eight hours per week had significantly higher scores on multi-tasking tests than those who did not play at all. However, participants who played for longer periods of time did not score significantly higher than those who did not play at all. This implies that eight hours per week is an optimum time for playing games to improve cognitive skills without the negative affects observed by Attewell, Suazo-Garcia and Battle (2003).

Blake (2008) comments on the growing pressure to ban video games. With FPS games such as *"Counter Strike*" and the age-restricted game *"Grand Theft Auto IV"* being played by tens of millions of players around the globe, politicians, administrators, and other critics argue that "killing police officers and directing pornography is bad for kids, and therefore playing video games is bad for kids" (p. 3). Playing violent video games appears to be on the rise, with the players themselves finding no validity of the transference of violence to the real world. In fact, many of the studies included in this review were conducted using FPS games. Sex and violence in videogames are a social issue that confronts us all, yet as a society we are inconsistent.

"Anyone who plays the game will end up doing in the real world exactly what they do in the virtual world" *Blake, 2008, p.1*

We condemn violent videogames and sexual content, yet at the same time we condone them and utilise them when convenient (Kearney & Pivec, 2007c). Hence, the issue of violent and sexual content in video games, and the question whether the perceived aggression transfers outside of the gaming environment, is outside the scope of this review because most of the literature discussing this facet of video games is purely opinion and often emotive.

The use of game-based learning for academic achievement

Wainess (2007) argues that games do not foster learning, cognitive skills or knowledge acquisition at all, and it is purely the context in which they are used that stimulates any learning to take place. Garris et al. (2002) argue that learning occurs only after reflection and debriefing, and that the game characteristics and instructional content are paramount in allowing this to happen. Shaffer (2006) partially agrees and states that the virtual worlds created by such games allow students to take action within the game and then reflect on this action, both during and after play. Many of these learning models differ, and with the use of video games for education becoming more popular, the issue of teacher education in the area of how to use video games and how they will achieve the learning outcomes still needs to be addressed.

A survey conducted by FutureLab (Facer, Ulicsak & Sandford, 2007) in 2005-6 of 2,334 secondary school students in the United Kingdom found that 59% of teachers would be willing to use game-based learning and 62% of students would welcome it. According to a similar poll released on April 8th 2008 in the United States (Project Tomorrow, 2008) of 319,233 students across 3,729 schools, 65% of teachers were interested in the use of games in the classroom. Neither of the surveys reported a widespread use of game-based learning in schools within the UK or the US, and the literature reviewed here suggests that video games are introduced into the classroom often only for the purpose of research.

One of the main barriers to the introduction of video games into the curriculum is the ability of the teacher to integrate the game into the topic. Egenfeldt-Nielsen (2006) concludes that the role of the teacher is crucial in achieving the learning outcomes from GBL, be it declarative or affective. Cramer, Ramachandran, and Viera (2004) agree with this and suggest that although the future of learning revolves around 3-dimensional environments that inherently promote learning, such as Active Worlds, the ability to utilize such tools is an issue for teachers. Dickey (2003) investigated a constructive learning approach using the 3-dimensional application Active Worlds. He suggested that the environment fostered a high level of peer support with the results showing collaboration between students, social negotiation and peer mentoring (affective learning). However, he concludes by suggesting that software influences the learning dynamics but does not create them and suggests that further research is needed to ascertain how products like video games can be used more effectively in a learning environment.

Commercial video games are known for creating social environments and cult followings surrounding the game play, the characters' attributes and player's abilities, and this is where affective learning and learning of social skills can occur.

> ***"Affective learning includes feelings of confidence, self-efficacy, attitudes, preferences, and dispositions"*** *Garris et al., 2002, p.457*

Both surveys (Facer, Ulicsak, & Sandford, 2007; Project Tomorrow, 2008) suggested a difference in the perceived learning outcomes of GBL. Teachers and students believed that computer skills are enhanced by utilizing games in the classroom, but whereas the teachers perceive the value to be in the uptake of declarative knowledge, the students believe the value is more in affective learning, i.e. social skills.

Garris et al. (2002) agree with the students and suggest that a substantial part of the learning is achieved outside of the game cycle during reflection and debriefing (*figure 1*).

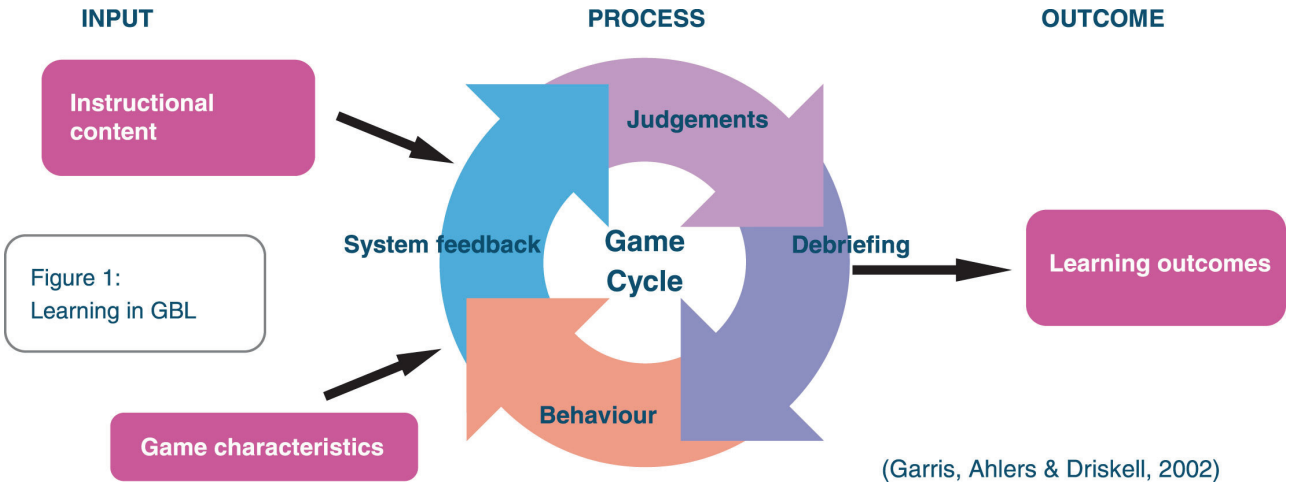


Figure 1: Learning in GBL

(Garris, Ahlers & Driskell, 2002)

Kolb (1984) states that learning follows a cyclic pattern, and the reflection on experience is part of the learning cycle itself *(figure 2),* similar to Shaffer's reflection-in-action. However, Paras & Bizzocchi (2005) argue that when play is broken up with reflection, the learning is reduced. But if the reflection is dispersed within the game by the design of the game, the learner/player takes responsibility for the learning outcomes.

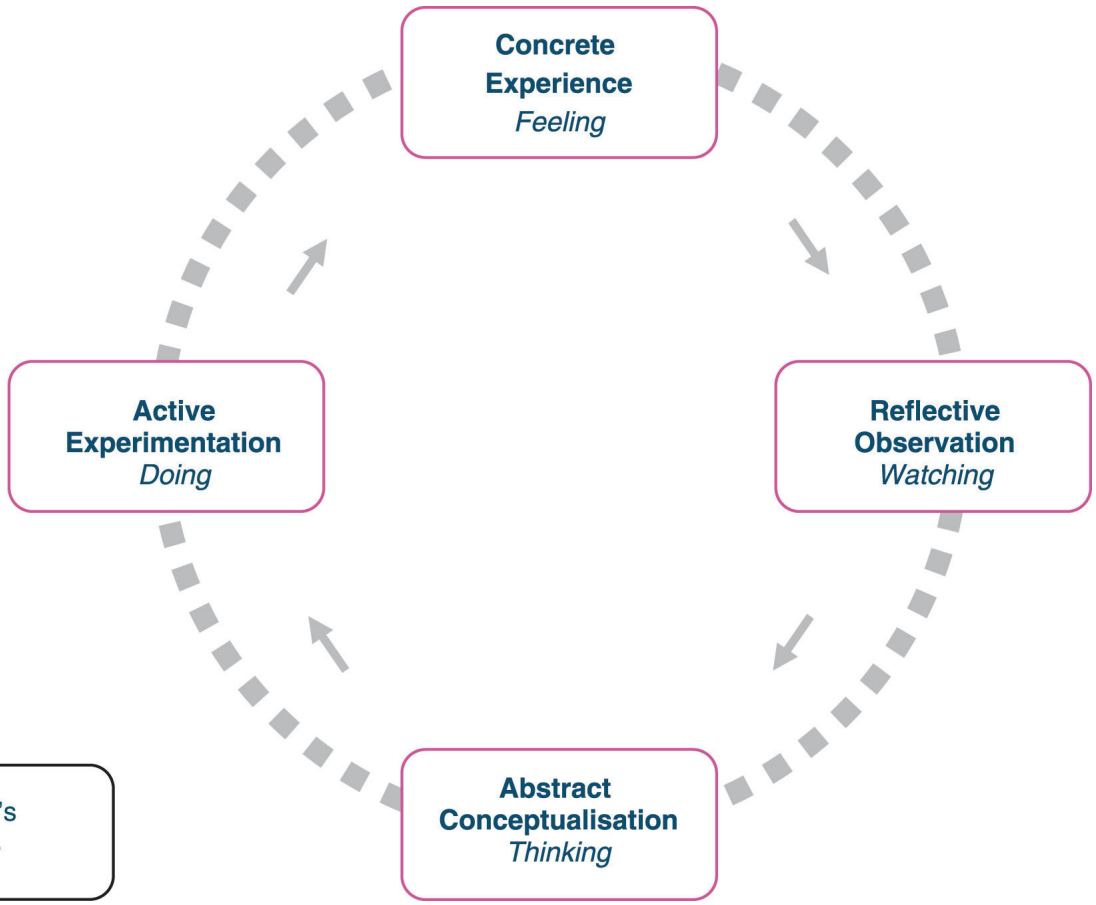


Figure 2: Kolb's learning styles

Video games can foster skill-based, knowledge-based and affective learning. Referring to the model of Game-Based Learning *(Figure 3)*, we can suggest where the different types of learning occur by means of the macro and micro game cycles, and include the player reflection within the game, during play and between levels. The skill-based learning appears to fit comfortably within the micro game cycle or levels within the game. For example, Rosser et al., (2007) found that the playing of commercial action games improved the surgical skills of laparoscopic physicians and decreased their error rate. There was no documented debriefing session for Rosser's study and it is assumed that the development of technical or motor skills occurs within the game itself.

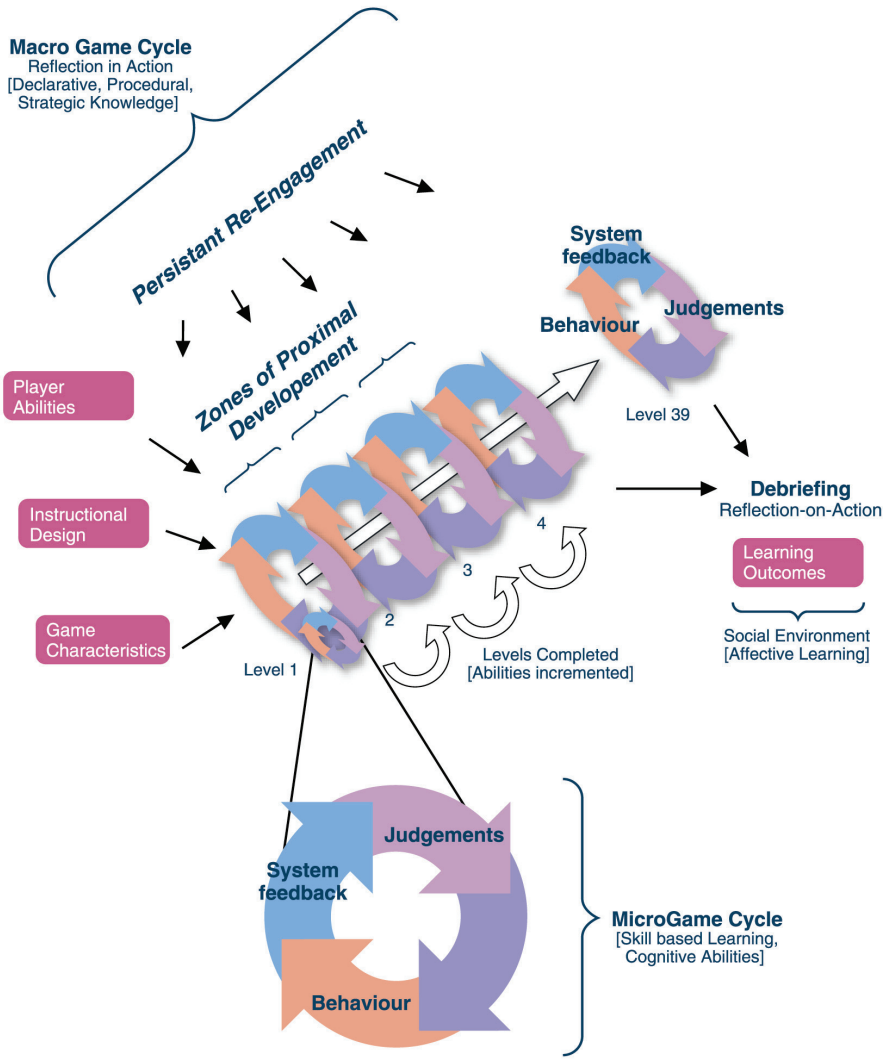


Figure 3: Recursive loops of Game-Based Learning (Kearney & Pivec, 2007a)

"As skills and abilities are attained, the player advances through the game and increments their knowledge."

Knowledge-based skills are defined within this model as declarative, procedural, strategic knowledge. Declarative knowledge is the facts and data that are required to complete a task or to perform well within the task, and these would be provided by the game or system feedback. Procedural knowledge is required to know how to approach the task and subsequently complete it. This could be referred to as knowing how to apply the declarative knowledge to a given situation. Strategic knowledge is the reasoning behind the task and how the task could be achieved in a different or more creative way. Each of these skills is achieved through reflection, but with many fast-action video games, it is reflection-in-action and occurs throughout the game cycle and within each level. As skills and abilities are attained, the player advances through the game and increments their knowledge. Players often do this without being aware of the process and this is where the teacher, as moderator, can highlight the meta-cognitive skills utilized. However, both the above-mentioned surveys found that there is a generation gap of technical knowledge with teachers rarely playing or even having knowledge about video games and the students being well versed in the technology.

Outline of available research into the use of game-based learning

Research into the use of video games for learning has produced inconclusive and contradictory results. Many publications focus on the negative effects of recreational video games (Gibbs & Roche, 1999; Anderson & Dill, 2000; Rollings & Morris, 2000), and many can be found to suggest the positive side in the learning effects provided by Game-Based Learning. Druckman (1995) suggests that these learning effects are purely a result of the effective motivation created by playing recreational games and supports Malone's (1981) theory – that the intrinsic motivation and the challenge created by video games is what improves the uptake of knowledge. Others claim that the drill and practice opportunity provided by video games improve learning (Wartella, 2002; Clark, 2004), yet some argue that there is no substantial proof that players learn from such games (Subrahmanyam et al., 2000) or that skills learned from video games are transferred outside of this domain (Egenfeldt-Nielsen, 2005).

The research that rejects the learning attributes of video games is often qualitative and merely a survey of available literature, as is the case of Subrahmanyam et al., (2000). Other research shows that skills are learned and retained, and can be transferred to other areas of life (Pillay et al., 1999; Stevens, 2000; Fullam et al., 2001; Rosser et al., 2007). Some research also contradicts the findings of other research, as with the earlier study by Egenfeldt-Nielsen's (2003) where he stated that eye-hand coordination was not improved when playing a popular arcade game title "Super Monkey Ball". However, in a recent study by Rosser et al., (2007) using the same game, eye-hand co-ordination was not only found to be improved, but also to be transferred outside the context of computer game play. This indicates that research in the area of GBL is varied and results differ as widely as the methodologies employed, as well as in the context of the usage of video games.

"Some argue that there is no substantial proof that players learn from such games."

For the purpose of this review, 42 major studies in the field of Game-Based Learning (GBL) over the past 20 years were reviewed. Many of them are also referenced in research on GBL by Beazzant (1999), Prensky (2001), Brown (2002), Gee (2004), Buchanan (2004), Oblinger (2004), Egenfeldt-Nielsen (2005), and others. The studies applied a wide variety of various methodologies, from quantitative experimental approaches applied in early studies, to the appearance of various qualitative approaches from 2000 on, to various mixed approaches observed from 2003. The following table (Table 1) elaborates on data extracted from the above

research studies, identifies the methodologies employed by each of them, classifies them and clearly shows a trend from quantitative experimental design towards a mixed methodology.

However, as suggested by Egenfeldt-Nielsen (2007), many of these studies do not adhere to rigorous academic research standards. He concludes by pointing out that most research into education with video games does not compare results with traditional or even alternative teaching methods.

> ***"Many of the studies have severe flaws related to researcher bias, short exposure time, no control group and lack integration of previous research"*** *Egenfeldt-Nielsen, 2007, p. 268*

Some studies have attempted to apply a research methodology, as in Betz (1995) and Adams (1998), yet even with a control group of students employed, the experimental group exposed to the games on the topic being taught had more exposure to the topic, as in Stevens (2000), mentioned earlier; hence it could be argued that these students scored higher merely through more time on the subject.

"It could be argued that these students scored higher merely through more time on the subject..."

Likewise, with the more recent studies of Rosser et al. (2007), where laprascopic surgeons improved their skills by playing "*Super Monkey Ball*", and Korczyn et al. (2007), where "*Tetris*" type games were used to treat degenerative diseases such as Alzheimer's, control group participants did not receive any other forms of training and hence spent less time on the topic. It could therefore be argued that video games are merely an alternative form of Drill and Practice methodology.

Table 1: **Methodologies in GBL Research**	**Quantitative**	Experimental	Quasi-experiment	Correlation	**Qualitative**	Ethnography	Grounded Theory	Case Studies	Phenomenon	Narrative	**Mixed Methods**
Dorval & Pepin (1986)	■	■									
Dowey (1987)	■	■									
McMullen (1987)	■	■		■							
Redd et al. (1987)	■	■									
Okagaki & Frensch (1994)	■	■									
Wiebe & Martin (1994)	■	■									
Betz (1995)	■		■								
Dolittle (1995)	■			■							
De Lisi & Cammarano (1996)	■	■									
Thomas et al. (1997)	■	■									
Brown et al. (1997)	■	■									
Klawe (1998)	■	■									
Adams (1998)	■			■							
Pillay et al. (1999)	■			■							
Feng & Caleo (2000)	■	■									
Hill & Agnew (2000)	■	■									
Noble et al. (2000)	■	■									
Stevens (2000)	■	■									
Subrahmanyam et al. (2000)					■		■				
Turnin et al., (2000)	■	■									
Fullam et al. (2001)	■	■									
Wylie (2001)					■	■					
Nova (2001)					■	■					
Gander (2002)	■	■									
Ko (2002)	■	■									
Curtis & Lawson (2002)					■				■		
Wartella (2002)					■		■				
Atwell et al. (2003)					■		■				
Joyner and TerKeurst (2003)					■	■					
Moore (2003)	■	■									
Green and Bavelier (2003)	■	■									
Antonietti & Mellone (2003)		■					■				■
De Castell & Jensen (2003)			■							■	■
Pillay (2003)			■			■					■
Rosas (2003)	■	■									
Squire et al. (2004)			■							■	■
Sweetser & Wyeth (2005)				■			■				■
Kearney (2005)			■				■				■
Buch & Egenfedt-Nielsen (2006)		■					■				■
Shaffer (2006)				■				■			■
Rosser et al. (2007)			■					■			■
Korczyn et al. (2007)		■						■			■

Examples of video games as an educational tool

Educational games that have been accepted into the curriculum are not common. Many have been developed by teachers with limited funding and technical skills, and often do not captivate the students. Ferdig (2007) suggests that most game developers and software publishers do not allocate money or resources to educational products, believing that such ventures are not profitable. The Federation of American Scientists (2006) agrees and states that most high-end computer and console games will cost anywhere between US$10 and $25 million and most never recover their development costs.

However, some commercial educational games such as "*Chemicus", "Physikus",* and *"Informaticus",* by Braingame Publishing, have the quality of a recreational game and also include defined learning outcomes. These games employ an interface very similar to the popular commercial adventure game "*Myst"* from UbiSoft, and provide an interactive story to transport the player into an immersive environment. A similar approach was used by students at the University of KwaZulu-Natal in South Africa (Seagram & Amory, 2004) to create a study aid for medical students. Their game immersed the players in narrative and encouraged them to play out the story by solving puzzles using prior knowledge of DNA.

"Most high-end computer and console games will cost anywhere between US$10 and $25 million and most never recover their development costs."

Reese (2007) suggests that video games and virtual worlds create player immersion (Kearney & Pivec, 2007b) and cites the concept of *flow* from Czikszentmihalyi (1990). Reese advocates that game worlds be used as a space for learning because of their immersive qualities. However, Calleja (2007) argues that the concept of immersion has been diminished through its widespread use in academic discussions. He promotes a game experience model to incorporate the concepts of immersion and presence, to further the understanding of social significance and personal values in video games. Buckingham and Burn (2007) conclude that this social significance has positive implications in education practice and cite examples where games have been used successfully within the curriculum, including students creating their own games for specific subjects.

Using video games within specific subjects

De Castell and Jenson (2006) created "*Contagion*", a role-playing game fostering interdisciplinary learning and targeted at children aged 10 – 15 (de Castell and Jenson, 2006). The game is based on traditional school subjects and related subject fields like technology, biology and medical sciences, as well as human and social sciences. The goal of the game is twofold. On one hand, the game should introduce health related topics and educate players by means of "serious play" about diseases, such as Severe Acute Respiratory Syndrome (SARS), West Nile Virus (WNV), Avian Fluand Acquired Immune Deficiency Syndrome (AIDS), and possible preventive behaviours. On the other hand, the game also provides a career preparation environment, where players can learn about and role-play various occupation of interest, e.g. community health officer, physician or medical researcher. The player entering the game world chooses one of these roles, which affect the development of the game play and the point of the view on the situation throughout the game. In the game the player is confronted with a situation of medical and humanitarian crisis and acts out the situation differently based on the respective role. The majority of the learning is based on active exploration.

The EC-funded project group known as "*eCIRCUS*" has developed an approach using GBL to support social and emotional learning. Using virtual role-play with virtual characters they establish credible and empathic relations with their students. The game *"FearNot"* has now been trialled on over 1000 children to test its ability to evoke empathic interactions and affective responses. The narrative-style game improvises dramas to address bullying problems for children aged 8-12 in the UK, Germany and Portugal. The authors (Dias, Paiva, Vala, Aylett, Woods, Zoll & Hall, 2006) found that nearly 80% of the students emotionally connected with the virtual characters. They conclude by recommending the platform be extended into other areas such as intercultural empathy.

"Quest Atlantis" (Barab, Thomas, Dodge, Carteaux and Tuzun, 2005) is a 3-dimensional virtual environment where a teacher can define various educational tasks in the form of quests, thus enabling the game to be adapted to different educational contexts. After registration on the web site, the environment can be accessed anywhere through the Internet. By completing the quests, i.e. educational activities, learners help to save the mythical Atlantis from a disaster. The Quest Atlantis virtual environment consists of different 3-D worlds that foster exploration and enable various social and goal oriented interactions. Babab et al. (2005) argue that "Quest Atlantis" attempts to reproduce the kind of environment that motivates players in commercial video games. The environment combines play, role-playing, adventure and learning.

"Nearly 80% of the students emotionally connected with the virtual characters."

Paul and Hansen (2006) from the University of Minnesota modified the game "*Neverwinter Nights"* to teach journalism. The contents of the textbook *Behind the message: information strategies for communicators,* which is used in one of the core courses, are transferred into a game. Here, the student acts as a reporter and must decide on the type of story angle they will cover in response to a railway accident and chemical spill. The aim of this game is that students learn to organise, interact, question and evaluate information from different resources. The game's library is stocked with hundreds of pages of documents and sources from online sites, and "Harperville", the town where the game is situated, is populated with dozens of characters who can be interviewed by the students, who act as rookie reporters. As players move through the information- seeking process, they take notes in a reporter's notebook within the game. They then compile their story, get a printout of their reporter's notebook and write a 1,000-word news story with the information they have gathered. The class instructor then assesses their notes to see the type of notes students have taken and how they used those notes in generating their stories.

The Orange County Public School in Florida utilized the commercial educational game from Tabula Digita (2006). They included the First-Person Shooter (FPS) game *"Dimexian"* as a study aid for algebra. Teachers were first trained to play the game and facilities were then set up for students to play after lessons had been completed. Dr. Clark, the Principal of the school, reports that students did not perceive it as learning mathematics and eagerly waited for their turn to play. As a result, she stated that not only were their problem solving skills improved but also collaboration between the students was also enhanced. Plans are now underway to hold tournaments with other schools and teams of players. The instructional design of the game is such that players with better algebra skills progress quicker than those with gaming skills.

"The role of the teacher as facilitator is paramount to the success of the learning outcomes..."

Sorensen and Meyer (2007) reviewed a game-based language course (English as a foreign language) introduced into primary schools in Denmark in 2006. Using a web-based platform, the game *"Mingoville"* contains 10 missions in which players complete activities focused around vocabulary, spelling and word recognition. Aimed at children aged 5 to 14, the product is written in Adobe Flash and has now been translated into 31 languages. The game centres on a village populated by flamingos and the player completes activities to advance through the game. The subscriber-based product is used within the school

and at home, and Sorensen and Meyer recommend that *"Mingoville"* is an excellent example of how Game-Based learning can successfully supplement traditional teaching.

Also from Denmark, Magnussen (2007) described a role-play game aimed at problem solving. In *"Homicide"* the players are forensic experts attempting to solve a crime. The students play in teams and the teacher acts as the chief of police. Aspects of the game are played on computer with face-to-face discussions with the students. Magnussen argues that the game is highly engaging for the students but that the role of the teacher as facilitator is paramount to the success of the learning outcomes.

> ***"We often falsely assume that the game itself will be powerful enough to cause change or learning that the outcomes will be used automatically for decision making. This is seldom the case"*** *Mayer & Bekebrede, 2008, p. 150*

Mayer and Bekebrede (2006) successfully implemented GBL using simulations. Their games, called *"Containers Adrift"*, the planning and design of an inland container terminal, *"Ventum On Line"*, the simulated management of a wind farm, and *"SIM MV2",* the planning of infrastructure for a 2nd port in Rotterdam, are all successfully utilized at Delft University of Technology. However, the authors suggest that simulation games are not effective in isolation and work best when they are embedded in a well structured education or training programme. They agree that teacher guidance or moderation and a debriefing session are critical steps in game-based learning.

Burmester, Burmester, and Reiners (2008) also created simulations of container terminals using the virtual environment of *"Second Life"*. They suggest that the blended learning approach taken by the University of Hamburg allows for a richer environment for the students and a safer one when teaching terminal logistics and management. However, they conclude that although the virtual world of *"Second Life"* suits their purpose at present, they have structured their resources as to be able to port them to other virtual worlds in the future.

The Simulations and Games in Education research group from METU (Middle Eastern Technical University in Turkey) School for Educational Technology used the public domain version of the popular commercial game *"Tomb Raider"*. Levels were modified to require Lara Croft, the heroine of the game, to solve problems using knowledge of photosynthesis, vitamins, fat, protein and carbohydrates (Cagiltay, 2006). The game was developed for 5th grade students and is freely available for download.

Rylands (cited in Entertainment and Leisure Software Publishers Association, 2006) used the popular computer game "*Myst*" to develop literacy and descriptive writing skills. By projecting the game on to a whiteboard in the classroom, Ryland discussed sights and sounds within the game in a group environment. The puzzles of the game were solved as a group and the teacher observed an improvement in negotiating skills. The students' adventures within the game were also recorded to practise their creative writing skills.

The EU-funded project "DISCOVER" (Dondi & Moretti, 2007), also lists examples of successful implementations of game-based learning in classrooms. Specifically, *"Living History"*, a common history web-based book that students can add to like a wiki; and *"aVataR@School project"*, a role-play scenario that takes place inside the virtual world of second life.

Designing games as part of the curriculum

Video games are often thought to provide the motivation necessary to learn. Clark (2004) maintains that commercial game designers are successful because they focus only on engaging the player and making the game fun to play. He states that it is the design of the interactivity that provides the motivation necessary to invoke persistent re-engagement by the player. This can be achieved at an emotional or an intellectual level,

but for the player to learn from the game, Clark argues that the game design must include action and consequence; learning will then be achieved through reflection.

In an educational game design course created by Pivec and Kearney (2007), they asked 75 information design students at the University of Applied Sciences Joanneum in Austria to role-play as commercial game designers. The challenge for students was to create a concept proposal for a publisher of educational games. The class was a role-play itself i.e. a game about designing a game, where students had to work in teams, create a game design company and take a specific role and responsibilities within the team e.g. game producer, game developer, programmer, etc. to contribute to the accomplishment of the task. The course covered topics including the process of commercial game design, taking into consideration the pedagogical design required to achieve the desired learning outcomes. When games are designed for learning, both the target audience and the learning outcomes have to be considered at the initial conception of the game. In this way teachers can easily recognise the value of this resource and the possibilities of including such games in the curriculum. Aspects of educational game design are tackled in more detail in Pivec, Koubek & Dondi (2004).

"The majority of the students found the course to be successful, with 70% of the students enjoying the topic."

Students were surveyed both before and after completing the course on their opinion of games in general and the potential for application of games for learning. Also surveyed was the motivational momentum of designing a game, i.e. whether they were more motivated and achieved better learning results. Based on this survey Pivec and Kearney (2007) wanted to assess if the students saw educational game development as a possible career path. On the post survey, 66% of the students agreed that designing educational games was a highly motivating topic and suggested that they now felt competent enough to write a professional educational game concept document. They also agreed that designing educational games could provide future career opportunities; however only 35% of them would consider this for their own career. The majority of the students found the course to be successful, with 70% of the students enjoying the topic despite not considering themselves to be game players. Those who did play video games did so only for recreation and had not used games in any of their schooling. However, upon completion of the course, 60% of the students showed a preference for using games to learn.

At the Middle Eastern Technical University in Turkey, software engineering students learn programming by designing and creating a video game prototype. Cagiltay (2007) observed that student abilities are improved in the areas of problem solving and the application of known skills, through constructivist learning. She concluded that student motivation was very high and their performance overall improved when compared to previous years.

Other researchers and teachers have also used game design to motivate learning. Lennon and Coombs (2006) targeted the topic of health, creating a role-play designing a board game about dengue fever. Their results showed that the games created highlighted the knowledge or misconceptions that the child had about the disease. They argue that appropriate instruction and subsequent debriefing by the teacher will increase and reinforce the level of declarative knowledge about the topic. They conclude by recommending the use of game design as an assessment tool for the knowledge of any subject.

Game-based learning to offset learning impairments

In 1995, Dr. Friedrich Masendorf (1995) published his findings with learning-disabled children. He stated that puzzle games such as *"Tetris"* and *"Blockout"* improve the spatial abilities critical for learning. These games allow children to explore geometrical shapes and visualize them from other angles. This research was confirmed by De Lisi and Cammarano (1996), playing the same puzzle games, and spatial visualisation abilities are suggested by Dorval and Pepin (1986) to assist with subjects like maths and science.

"Two-dimensional and three-dimensional spatial abilities can be cultivated in learning-disabled children" *Masendorf, 1995, p.49*

Unfortunately, today's generation do not play games like *"Tetris"* or *"Blockout".* They are more captivated by action games, such as First-Person Shooter games (FPS), or Role-Playing (RPG) and Real-Time Strategy (RTS) games -- all recreational commercial video games.

In an article by Griffiths (2005), references are made to many uses of video games for rehabilitation. The article cites Redd, Jacobsen, DieTrill, Dermatis, McEvoy & Holland (1987) where video games were successfully used to offset the nausea felt by children during chemotherapy. Griffiths suggests that video games may be used in the areas of:

- Treatment of autism and ADHD
- Spatial and learning disabilities
- Cognitive rehabilitation for young and old.
- Development of social and communication skills.
- Pain management and health care.

In a paper on e-inclusion by Pivec, Dziabenko & Kearney (2005), a call is made for innovative research into the use of video games to offset learning disabilities. Kearney (2006) suggests that the characteristics of many recreational commercial video games create player immersion that will enhance the cognitive effect that is required by the above applications. Klingberg, Forssberg & Westerberg, (2002) agree and suggest that some games assist the improvement of working memory and that this will help children with attention deficit disorders, as well as rehabilitation after stroke and traumatic brain injuries. Klingberg et al. are now the scientific advisors for the commercial company Cogmed, who created and market the game-based learning product *"RoboMemo"* – a computer program designed to assist the improvement of work memory. *"RoboMemo"* is based on the same theories as Nintendo's *"Train your Brain"* games. The object of these games is to repeat the numbers of images shown on the screen or letters and numbers sounded, in the same order or reverse order. As with Doman's (1986) theory of repetition, CogMed suggest that the participant uses *"RoboMemo"* for 30 minutes per day, for five weeks. At the end of this period, the company reports that 80% of participants not only have increased attention span, but also improved academic achievements (although not quantified) due to an increase in working memory.

"Many recreational commercial video games create player immersion that will enhance the cognitive effect."

Doman (1986) argues that "how well we learn is a direct reflection of how well we receive, process, store and utilize information", all functions of working memory. Jaquith (1996) suggests that a one-digit increase in score from Digit Span Forward tests (a widely accepted test of working memory capacity) correlates with a significant increase in academic achievement, specifically an improvement in an individual's academic function relative to their suggested grade level. Jaquith shows a direct correlation between the results of Digit Span tests and academic test scores – the greater the working memory capacity, the higher the academic test scores. Students who had participated in the Stanford Achievement Test (SAT) for Total Reading, Maths, Listening, Thinking, Word Reading, Language, Letters/Sounds and Spelling had their scores compared with their Digit Span test scores (Auditory and Visual tests).

The improvement in cognitive abilities such as working memory can also be applied to offset learning disabilities from degenerative diseases like Alzheimer's, and learning impairments resulting from problems such as ADHD and late effects resulting from the treatment of cancer for teenage children. For example, in a recent study of 121 elderly people, computer puzzle games such as "*Tetris"* were used as a trial against a computerised cognitive training program called *"Mindfit"* (Korczyn, Peretz, Aharonson & Giladi, 2007). The results showed that both the games and the program improved short-term memory, spatial learning and attention skills. The researchers stated that although the *Mindfit* program improved skills by a greater percentage, the games also significantly improved skills after relatively short periods of play. The participants were required to play three times per week for half an hour in each session over a period of 3 months, and it is suggested that this may assist with the treatment of the early onset of Alzheimer's disease.

In an earlier study by Gottfried (2004), 14 children suffering from attention deficit or ADHD were requested to play a game-like cognitive training program, three times per week for a duration of 20 minutes. After a period of 12 to 22 weeks, all participants reportedly showed significant improvements in attention span, behaviour and academic achievement.

Pearson and Bailey (2008) approached the task from the hardware viewpoint, using Commercial-off-the-shelf (COTS) games with the Nintendo Wii. Their work with disabled students showed that not only could the Wii promote improvement in physical movement, but it also assisted with the social and self-esteem issues of their participants. They conclude with the call for teachers to work together and develop lesson plans to incorporate such devices.

"The Wii promoted improvement in physical movement, but also assisted with social and self-esteem issues."

In summary, Griffiths (2005) states that video games have positive potential for therapeutic and rehabilitation applications. He suggests that applications developed in the education and health sections using video games have been successful but calls for further research to be done in these areas.

Frameworks for game-based learning

Brown (2002) states that learning comes as the result of a framework or environment that fosters learning rather than as a result of teaching. He maintains that today's students look upon technology as an integral part of life and a tool that they take for granted; for many of them computing has been part of their learning since early childhood. Brown suggests that there is a shift in the way that students learn. At tertiary level, this has only been embraced by a handful of institutions, creating a problem in student retention. The shifts include the literacies used, from text to multimedia; classroom practice, from teacher-centred to student-centred; and reading, from solitary to social exploration. It has been claimed that video games are ideally situated to cater for these students. Oblinger (2004) suggests that educational environments involving video games lead to deeper learning, and Buchanan (2000) states that the cognitive conflict from video games enhances learning.

Human behaviour is learned and decisions are made by evaluating the situation and considering all the options. Buchanan (2004) notes that game designers challenge players by using "bots" or non-player characters (NPCs) in their games that mimic human behaviour. Bots do this by using what programmers call a decision tree. Human players do it intrinsically by monitoring the situation and manipulating it based on their own thoughts and perceived skill set. This is meta-cognition. Buchanan claims that experienced players consciously increase their mental space for visualization and manipulation of

"Human players do it intrinsically by monitoring the situation and manipulating it based on their own thoughts and perceived skill set".

problems. He suggests that game players possess an increased ability to multitask and mentally sort information. Buchanan concludes that video games include all the underpinning characteristics for quality learning. Garris et al. (2002) list these characteristics as being:

- Fantasy – Imaginary or fantasy context, themes, or characters.
- Rules/Goals – Clear rules, goals, and feedback on progress towards the goals.
- Sensory Stimuli – Dramatic or novel visual and auditory stimuli.
- Challenge – Optimal level of activity and uncertain goal attainment.
- Mystery – Optimal level of informational complexity.
- Control – Active learner control.

Garris et al. (2002) also agree that a substantial part of the learning is achieved outside of the game cycle during reflection and debriefing (cf. figure 1, above).

Player immersion for enhanced learning

Beazzant (1999) states that the characteristics of commercial video games create an environment where players are compelled to play to the extent of forming addictions. Garris et al. (2002) maintain that this addiction, or persistent re-engagement by the player, is what instructional designers strive to create when designing tutorials and educational software. With the player or learner continually repeating the game cycle, video games foster behaviourism and the learning is achieved from drill and practice. Yet de Castell and Jensen (2003) argue that many educational games are not successful because they fail to immerse the player in the way that commercial video games do, and it is this immersion that fosters a deep learning, not the low level of learning from drill and practice.

> ***"Video games are practice opportunities for cognitive skills"*** *Quinn, 1997, p.1*

In the study by Kearney (2005), the game "*Counter-Strike"* was observed to immerse the player in the game. Two teams of eight players sat quietly and focused for over two hours on what appeared to be very serious game play. Yet other teams in the same study played a similar game called "*Quake III"* and no player immersion was observed. The difference between the two games was that "*Quake III"* did not create the same level of challenge or difficulty that *Counter-Strike* did. *Counter-Strike* also had more rules, consequences of failure were increased and the goal of the game was detailed enough to inform the player of the relevance of the game play, as suggested earlier in the list of characteristics by Garris et al. (2002).

Quinn (1997) claims that video games can be highly effective when used in an educational environment. He also cites the concept of *flow* from Czikszentmihalyi (1990), in conjunction with Malone's (1981) critical elements of fantasy, challenge and curiosity; both concepts are used and extended by Garris et al. (2002) for their model of GBL. Quinn goes further to suggest that Malone's challenge element is what maintains player engagement and creates a "zone of difficulty where learning occurs". This could also be compared to Vygotsky's (1978) Zone of Proximal Development (ZPD), where the scaffolding or level of cognitive challenge must be appropriate for the learner's current abilities or learning will not occur. Quinn argues that cognitive challenges within the game lead to the practice of skills for problem solving. This may be perceived as drill and practice; however, it can be called "recursive learning".

The success of any computer game, be it recreational or educational, is dependent on the engagement of the player during the first and subsequent interactions. A literature search of desired game characteristics results in varied opinions; however, they all suggest that the success of a game is increased when the

immersive characteristics of that game focus the attention of the player. They state that when immersion occurs, meaning the loss of the sense of time through the complete focus on the task at hand, the game motivates the player to repeatedly engage in play. This type of motivation has been described as flow. The concept of flow can be used to identify which video games foster the persistent re-engagement of the player and eye-tracking technology can be utilized to verify player immersion. However, unless the game scaffolds the player's abilities, this immersion will be lost and the game will fail. The player's abilities are incremented in a recursive loop and this is shown in the model described. The scaffolded level of skill requirement is what creates the immersion and the player's desire to engage.

> "The game motivates the player to repeatedly engage in play."

A constructivist GBL platform

There are specific educational domains where game-based learning concepts and approaches have a high learning value. These domains are interdisciplinary topics where skills such as critical thinking, group communication, debate and decision-making are of high importance. Such subjects, if learned in isolation, often cannot be applied in real world contexts. To create a successful game-based learning opportunity, defined steps of game design with elements of learning and engagement should be taken into consideration (Pivec & Pivec, 2008). The main areas to be considered are as follows.

- Determine a pedagogical approach for the lesson plan (how you believe learning takes place)
- Situate the task to achieve the learning outcome in a model world
- Elaborate on the details needed to complete the task
- Incorporate the underlying pedagogical support
- Map the learning activities to interface actions of the game
- Map the learning concepts to interface objects of the game

When designing an example of an educational game we have to reflect upon the didactic approach and related topics. We have to create the situation asking, "What do we want learners to learn?" Before defining the activities we should reconsider the saying *failure opens the gate to learning* and we should try to provide an answer to the question "Why?" There are many interactive learning techniques that have already been used in game-based learning. One of those techniques is learning from mistakes, where failure is considered a point where the user gets some feedback. In game-based learning, making a mistake - or trial and error - is a primary way to learn and is considered the motivation for players to keep on trying. In games, we learn through failure and consequence, and feedback is provided in the form of action (as opposed to feedback in the form of the text explanation that is provided in instructional material).

Salen (2007) and Buckingham, Burn, and Pelletier (2005) advocate that allowing students to design and create their own educational games encourages meta-level reflection and fosters creativity. Yatim (2008), at the University of Magdeburg, tested this with students between the ages of 9 to 12, and found that through designing their own educational games students appeared to be enthusiastic and showed a high level of interest. Prensky (2006) also suggests that games design by students for students would have a higher level of engagement, although no supporting research was offered. However, this would possibly overcome some of the barriers to acceptance (Rice, 2007) by allowing teachers to work with students, aligning the game content to the curriculum.

However, there are various platforms available that offer an environment where teachers and trainers can define their own online role playing scenarios or simulation, and provide the opportunity for learners to apply factual knowledge and to gain experience through the digital world. Teachers can define new games or adopt and modify sample games without any programming skills. Products such as *"Unigame"*, *"Fablusi"*, and *"The Training Room"* provide a variety of communication means within the scenarios; players can communicate with the use of discussion forums, text and voice chat modules as well as through multi-user video conferencing. An important feature of these products is the collaborative learning design, which allows participants to exchange information as well as to produce ideas, simplify problems, and resolve the tasks. When using these platforms, the teacher is the active partner, moderator and advisor of the educational process (Pivec & Pivec, 2008).

Simulations versus role play games

Salen and Zimmerman (2003) define games as systems where a player engages in conflict defined by a defined set of rules and the result is a defined outcome. They argue that while games and role-plays share the key features that define them both as games, they are different in one critical respect: role-plays do not always have a defined outcome. However, Salen and Zimmerman concede that this depends on the framework or platform that provides the role-play. They suggest that where a game and a role-play overlap is that they are systems requiring players to interact according to a set of rules in a contest or in conflict (Salen & Zimmerman 2003).

Linser (2008) suggests that for pedagogical purposes a role-play is closer to a simulation than a game. He argues that with the acquisition of real world knowledge, and the understanding and skills acquired by the player, a role-play is designed as an attempt to simulate processes, issues and conditions that exist in the real world.

> ***"A role-play simulation game is thus a dynamic artificial environment in which human 'agents' interact by playing roles with semi-defined characteristics, objectives and relations to one another and within a specified scenario"*** *Linser, 2008, p.5291*

Kelly (2005) argues that simulations have an enormous impact on education and many products such as Microsoft's "*Flight Simulator*" are in fact simulations and neither games nor role-plays.

In the model of game-based learning shown in Figure 3, the inclusion of instructional design is a critical element of the game to enable the achievement of the learning outcomes. Akilli (2007) argues that while game designers need to improve their instructional design and, equally, instructional designers need to give more attention to game design principles, there is a lack of guideline documentation supporting this area of pedagogy.

"A role-play can include all the engagement, immersion, and motivation that are inherent in the game environment."

Linser (2008) concludes by stating that while he considers role-play a simulation, given the right environment and delivery platform, a role-play can include all the engagement, immersion, and motivation that are inherent in the game environment. Fortugno and Zimmerman (2005) agree and suggest that teachers and trainers do not yet understand the use and potential of games and most games do not include sound pedagogical principles in their design.

A level-up for teachers

Although, when surveyed, the majority of teachers are willing to incorporate video games into their lesson plans, most of the research, techniques and the appropriate games are rarely promoted to them and they seldom read the journals where these are publicized (Sprague, 2004).

Video games and their appropriate use for education vary considerably. Taxonomies of game types and lists of recommended games are available (Pivec, Koubek, & Dondi, 2004; Pivec, 2008) but teachers cannot be expected to know how to integrate the games into their lessons to achieve the desired learning outcomes. Also the games themselves can take a considerable amount of time to learn, often with the students knowing more about the game than the teacher.

"Teachers cannot be expected to know how to integrate the games into their lessons to achieve the desired learning outcomes."

Becker (2007) addressed this problem with a course to teach teachers about commercial video games and the use of them within a classroom environment. The course ran for six weeks, with the participants meeting for three hours, twice per week. The participants were given a choice of two projects: (1) to design an educational game and complete a professional design concept similar to the course by Pivec and Kearney (2007) [see section 4.2], or (2) to design a lesson plan to use an existing commercial computer game. Throughout the duration of the course, topics discussed included the appropriateness of violent games, instructional design of commercial games, varying platforms for games, and how to assess the games themselves. Specific games were also analysed and these included commercial recreational games such as *"Black and White",* and free-to-use online games such as *"Food Force"*. The playing of the games was a key feature of the course.

Becker (2007) rated the course a major success but acknowledged that with only 18 participants out of a local teacher population of over 10,000, she had not solved the problem. Becker concludes by stating that her objective was not to turn the teachers into computer game players, but to encourage them to play games and critique them for use within their lessons.

Conclusions

Video games have been around for many years and game-based learning has been the topic of many publications. Research results suggest that either the game itself or the environment which it creates can enhance the learning process. However, the uptake of this technology in the classroom has been slow with the major barriers being a lack of knowledge by the teacher in how to use the resource, a lack of time to prepare in adapting the game for the curriculum, and a lack of adequate technology. Teachers are trained in traditional methods that do not include the use of games in the curriculum. Only researchers and a few innovative teachers have successfully embraced video games for learning, although many others are willing to do so given the necessary resources and assistance to do so.

Surveys in both the UK and the US show that students are critical of educational games as the expected quality of a commercial recreational game is often missing. Modifying commercial games has become popular to avoid this, as has allowing the students to design their own game – either to concept level or a prototype if resources allow. Where a game is utilized as part of a lesson, a commercial-off-the-shelf (COTS) and often recreational game or a commercial game that has been modified or adapted for the desired learning outcome can be used. This has been done successfully as highlighted in the above literature, but care must be taken to adhere to the comprehensive licensing agreements of the publisher. As games can extend outside the classroom, they also provide an ideal platform for study aids and to assist with learning impairments and the medical profession has been quick to appreciate the benefits of this technology.

> “Role-play games and simulations provide ideal and safe environments for learning.”

Games for learning vary from single player to multiplayer games. Different types of games have different sets of features that have to be considered in respect to their application for education. For declarative knowledge, features such as content, assessment ability and the scaffolding of levels along with time constraints are all very important. To acquire skills, games must be session based, where attention is paid to the graphical details, thus enabling an immersive situation. In the area of decision making and problem solving, games should be narrative based where chance is a factor, accurate in the problem descriptions, with background knowledge of the content being vital to successful completion. Role-play games and simulations provide ideal and safe environments for learning. If learning is defined as the acquisition of knowledge or skills through experience, practice or study and learning outcomes are the knowledge, skills and abilities that the student will possess following the learning experience, then video games can be used as a supplement to traditional teaching.

However, part of the process of choosing and utilizing video games for learning includes the identification and consideration of constraints in the learning setting, the computer skills of both students and teachers, and knowledge of how the desired learning outcomes will be realized. Other issues include technical requirements, licensing policies, sustainability, and more. Video games are an untapped resource in the field of education and will remain so until adequate teacher resource is provided.

References

Adams, P., C. (1998). Teaching and learning with SimCity 2000. *Journal of Geography, 97*(2), 47-55.

Akilli, G. K. (2007). Games and Simulations: A new approach in Education? In Gibson, D., Aldrich, C. and Prensky, M. (eds.), *Games and Simulations in Online Learning: Research and Development Frameworks* (pp.1-20). Hershey PA: Information Science Publishing.

Anderson, C. A., & Dill, K. E. (2000). Video games and aggressive thoughts, feelings, and behavior in the laboratory of life. *Journal of Personality and Social Psychology, 78*, 772-90.

Antonietti, A., & Mellone, R. (2003). The difference between playing games with and without the computer: A preliminary view. *Journal of Psychology, 137*(2), 133-44.

Attewell, P., Suazo-Garcia, B., & Battle, J. (2003). Computers and young children: Social benefit or social problem? *Social Forces, 82*(1), 277-96.

Barab, S., Thomas, M., Dodge, T., Carteaux, R., & Tuzun, H. (2005). Making learning fun: Quest Atlantis, a game without guns. *Educational Technology Research and Development. 53*(1), 86-107.

Beazzant, S. (1999). Dissertation: Children and video games: What's the fuss? Retrieved 12 April, 2003, from http://www.scottbezzant.btinternet.co.uk/Downloads/Dissertation.htm

Becker, K. (2007). Digital game-based learning once removed: Teaching teachers. *British Journal of Educational Technology, 38*(3), 478-88.

Bennett, S., Maton, K. & Kervin, L. (2008).The ‘digital natives’ debate: A critical review of the evidence. *British Journal of Educational Technology.* (in press)

Betz, J. A. (1995). Computer games: Increase learning in an interactive multidisciplinary environment. *Journal of Educational Technology Systems, 24*(2), 195-205.

Blake, B. (2008). Go Ahead, Steal My Car. *The Chronicle of Higher Education, June 27, 2008.* Retrieved from http://chronicle.com/weekly/v54/i42/42b00601.htm

Brown, J. (2002). *Learning in the digital age.* In *The Internet & the University: Forum 2001* edited by Maureen Devlin, Richard Larson and Joel Meyerson, pp. 65-91. Published as a joint project of the Forum for the Future of Higher Education and EDUCAUSE, 2002

Buch, T. & Egenfeldt-Nielsen, S. (2006). *The learning effect of "Global Conflicts"*: Palestine. Conference Proceedings Media@Terra, Athens, April 2006.

Buchanan, K. (2004). How an educator thinks about computer games. *On the Horizon.* Retrieved 21st December, 2004, from http://www.msu.edu/~buchan56/games/educator_thinks_games.htm

Buckingham, D., Burn, A., Pelletier, C. (2005). Making games: Creative game authoring in and beyond the classroom. Immersive Education. http://www.immersiveeducation.com/uk/documents/MakingGamesIOE.pdf

Burmster, A., Burmester, F., & Reiners, T. (2008). *Virtual Environment for Immersive Learning of Container Logistics.* In *Proceedings of World Conference on Educational Multimedia, Hypermedia and telecommunications 2008*, Vienna, Austria, pp. 933-35

Calleja, G. (2007) *Digital Games as Designed Experience: Reframing the Concept of Immersion.* PhD Thesis, Victoria University of Wellington. Retrieved from http://www.gordoncalleja.com/phdthesis.html.

Cagiltay, K. (2006). Symposium "Game-Based and Innovative Learning Approaches: A Symposium in conjunction with SIG-GLUE" held at the AACE World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA 2006), Orlando, Florida.

Cagiltay, N. (2007). Teaching software engineering by means of computer-game development: Challenges and opportunities. *British Journal of Educational Technology, 38*(3), 405-15.

Clark, C. (2004). *The principles of game based learning.* Paper presented at the NETC/LSC Conference, Crystal City, VA.

Cramer, M., Ramachandran, S., & Viera, J. (2004). *Using computer games to train information warfare teams.* Paper presented at the Industry/Interservice, Training, Simulation & Education Conference (I/ITSEC 2004), Orlando, Florida.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper and Row.

Curtis, D., & Lawson, M. (2002). Computer adventure games as problem-solving environments. *International Education Journal, 3*(4), 43-56.

de Castell, S., & Jenson, J. (2003). Serious play. *Journal of Curriculum Studies, 35*(6), 649-665.

de Castell, S. & Jenson, J. (2006). How Content Matters: Rethinking Educational Games. In Pearson E., & Bohman P. (Eds.). *Proc. of ED-MEDIA'06*, Orlando, Florida, USA, 2006, pp. 1802-08.

De Lisi, R., & Cammarano, D. M. (1996). Computer experience and gender differences in undergraduate mental rotation performance. *Computers in Human Behavior, 12*, 351-61.

Dias, J., Paiva, A., Vala, M., Aylett, R., Woods, S., Zoll, C., (2006). Empathic Characters in Computer-based Personal and Social Education. In M. Pivec (ed.), *Affective and emotional aspects of human-computer interaction: Emphasis on game-based and innovative learning approaches*. Amsterdam: IOS Press BV.

Dickey, M. (2003) Teaching in 3D: Pedagogical Affordances Constraints of 3D Virtual Worlds for Synchronous Distance Learning. *Distance Education, 24*(1).

Dolittle, J. H. (1995). Using riddles and interactive computer games to teach problem-solving skills. *Teaching of Psychology, 22*(1), 33-6.

Donchin, E. (1989). The learning strategies project. *Acta Psychologica, 71*, 1-15.

Dondi, C. & Moretti, M. (2007). Discover: Helping teachers to discover the pleasure of learning and teaching. *British Journal of Educational Technology, 38* (3), 519-22.

Doman, R.J. (1986). Auditory and Visual Digit Spans. Learning How You Learn series: Processing Information. National Association for Child Development

Dorval, M., & Pepin, M. (1986). Effect of playing a video game on a measure of spatial visualization. *Perceptual Motor Skills, 62*, 159-62.

Dowey, J. A. (1987). Computer games for dental health education in primary schools. *Health Education Journal, 46*(3).

Druckman, D. (1995). The educational effectiveness of interactive games . In D. Crookall & K. Arai (eds.), *Simulation and gaming across disciplines and cultures*. Thousand Oaks, CA: Sage, pp. 178-87

Egenfeldt-Nielsen, S. (2003). Keep the monkey rolling: Eye-hand coordination in super monkey ball, *Digra - Level up conference 2003*. Utrecht University.

Egenfeldt-Nielsen, S. (2005). *Beyond edutainment: Exploring the educational potential of video games.* Unpublished PhD thesis. IT-University of Copenhagen, Copenhagen.

Egenfeldt-Nielsen, S. (2006). Overview of research on the educational use of video games. *Digital Kompetanse*, *3*(1), 184–213.

Egenfeldt-Nielsen, S. (2007). Third Generation Educational Use of Computer Games. *Journal of Educational Multimedia and Hypermedia, 16*(3).

Entertainment and Leisure Software Publishers Association (2006). Unlimited Learning; Computer and Video Games in the Learning Landscape. Retrieved from http://www.elspa.com/assets/files/u/unlimitedlearningtheroleofcomputerandvideogamesint_344.pdf

Federation of American Scientists, (2006). Harnessing the Power of Video Games for Learning. Proceedings of the Summit on Educational Games, October 25th, 2005, Washington DC.

Facer, K, Ulicsak, M. and Sandford, R. (2007). "Can computer games go to school?' in *Emerging technologies 2007, BECTA,* Retrieved May 12, 2007 from www.becta.org.uk

Feng, S. & Caleo, J. (2000). *Playing Computer Games Versus Better Learning*. Paper presented at the Annual Conference of the Eastern Educational Research Association (70th, Clearwater, FL, February 16-19, 2000).

Ferdig, R. (2007). Learning and Teaching with Electronic Games. *Journal of Multimedia and Hypermedia (2007) 16*(3), 217-23.

Fortugno, N. & Zimmerman, E. (2005). Learning to Play to Learn - Lessons in Educational Game Design. Retrieved 8 July 2008, from: http://www.gamasutra.com/features/20050405/zimmerman_01.shtml

Fullam, K., Marriot, A., & Tierney, S. (2001). The effects of video game playing on motion processing abilities. *CS395T: Introduction to Cognitive Science Source Project* Retrieved 21st December, 2004, from http://www.lips.utexas.edu/~kfullam/pdf/CogSciReport.pdf

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming, 33*(4), 441-67.

Gander, S. (2002). Does learning occur through gaming? *Electronic Journal of Instructional Science and Technology, 3*(2).

Gee, J. (2003). *What video games have to teach us about learning and literacy*. New York: PalGrave-McMillan.

Gee, J. (2004). *Learning by design: Games as learning machines.* Paper presented at the Game Developers Conference, San Jose, CA.

Gentile, D. A. (2005). *The psychology behind video games as excellent teachers: A dimensional approach.* Paper presented at the 91W EMS/Department of combat medical training education conference, San Antonio.

Gibbs, N., & Roche, T. (1999). The Columbine Tapes. *Time, 154,* 40-51.

Gottfried, B. (2005). Using sharperbrain, a computer-assisted program, to treat attention deficit disorders (ad/hd) and learning disabilities (ld): Review of 3 case studies. Retrieved 1 March, 2007, from http://www.sharperprograms.com/Cases-SB.html

Green, C., & Bavelier, D. (2003). Action video game modifies visual attention. *Nature, 423*, 534-37.

Griffiths, M. (2005). Video games and health. *British Medical Journal, 331*(7509), 122-23.

Heil, M., & Agnew, B. (2000). *The effects of previous computer experience on air traffic-selection and training (at-sat) test performance* (No. DOT/FAA/AM-00/12). Oklahoma City: Civil aeromedical institute.

Jaquith J (1996). The role of short term memory on academic achievement. Retrieved May 2007 from http://www.nacd.org

Joyner, L., & TerKeurst, J. (2003). *Accounting for user needs and motivations in game design.* Paper presented at the 1st Global Conference in Interactive Convergence: Research in Multimedia, Prague, Czech Republic.

Kearney, P. (2005). *Cognitive callisthenics: Do fps computer games enhance the player's cognitive abilities?* Paper presented at the DiGRA 2005 Changing Views: Worlds in Play International Conference, Vancouver, Canada.

Kearney, P. R. (2006). Immersive environments: What can we learn from commercial computer games? In M. Pivec (Ed.), *Affective and emotional aspects of human-computer interaction: Emphasis on game-based and innovative learning approaches*. Amsterdam: IOS Press BV.

Kearney, P. & Pivec, M. (2007a*). Recursive loops of game based learning*. In Proceedings of World Conference on Educational Multimedia, Hypermedia and telecommunications 2007 Vancouver BC, Canada, 2007, pp. 2546-53

Kearney, P. & Pivec, M. (2007b). Immersed and how? That is the question. *Games in Action*. Gothenburg, Sweden.

Kearney, P. & Pivec, M. (2007c). Sex, Lies and Videogames. *British Journal of Education Technology*, Vol. 38, Issue 3, May 2007

Kelly, H. (2005). Games, cookies, and the future of education. *Issues in Science & Technology, 21*(4), 33-40

Klawe, M. M., & Phillips, E. (1995). *A classroom study: Electronic games engage children as researchers*. Paper presented at the CSCL 1995, Bloomington, Indiana.

Klingberg, T., Forssberg, H., & Westerberg, H. (2002). *Training of working memory in children with ADHD.* Journal of Clinical & Experimental Neuropsychology, *24*, 781-91.

Klopfer, E. (2008). *Augmented Learning; Research and Design of Mobile Educational Games*. Massachusetts: The MIT Press.

Ko, S. (2002). An empirical analysis of children's thinking and learning in a computer game context. *Educational Psychology, 22*(2), 219-33.

Kolb, D. (1984). *Experiential learning: experience as the source of learning and development*. Englewood Cliffs, N.J: Prentice-Hall.

Kovalik, L.M., & Kovalik, D. (2008) A lesson learned through gaming. *Simulation & Gaming. An Interdisciplinary Journal of Theory, Practice and Research. 29* (1), 118-25

Korczyn, A. D., Peretz, C., Aharonson, V., & Giladi, N. (2007). *Computer based cognitive training with mindfit improved cognitive performances above the effect of classic video games; prospective, randomized, double-blind intervention study in the elderly.* Paper presented at the 8th International Conference AD/PD 2007, Salzburg, Austria.

Lennon, J.L., & Coombs, D.W. (2006), Child-invented health education games: A case study for dengue fever. *Simulation & Gaming. An Interdisciplinary Journal of Theory, Practice and Research. 37*(1), 88-97

Levy, F., & Murnane, R. (2004). *The New Division of Labor: How Computers are Creating the Next Job Market.* Princeton, NJ: Princeton University Press.

Linser, R. (2008) The Magic Circle – Game Design Principles and Online Role-Play Simulations. Proceedings of *World Conference on Educational Multimedia, Hypermedia and telecommunications 2008* Vienna, Austria, 2008, pp. 5290-97.

Noble, A., Best, D., Sidwell, C., & Strang, J. (2000). Is an arcade-style computer game an effective medium for providing drug education to school children? *Education for Health, 13*(3), 404-06.

Nova, N. (2001). *Awareness tools: Lessons from quake-like.* Paper presented at the Playing with the Future Conference, Manchester, UK.

McMahan, A. (2003). Immersion, engagement, and presence: A method for analyzing 3-d video games. In M. J. P. Wolf & B. Perron (Eds.), *The video game theory reader* (pp. 67-86). New York: Routledge.

Magnussen, R. (2007). Teacher roles in learning games - When games become situated in schools. *Digital Games Research Association 2007 Conference: Situated Play, Tokyo,* 610-15.

Malone, T. W. (1981). What makes video games fun? *Byte, 6*(12), 258-77.

Malone, T. W., & Lepper, M. R. (1987). *Aptitude, learning and instruction iii: Cognitive and affective process analysis*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Masendorf, F. (1995). Training learning-disabled children's spatial ability by computer games. *European Education,* Summer *27*(2), 49.

Mayer, I. & Bekebreda, G. (2006). Serious games and simulation based e-learning for infrastructure management. In M. Pivec (Ed.), *Affective and emotional aspects of human-computer interaction: Emphasis on game-based and innovative learning approaches*. Amsterdam: IOS Press BV.

Menn, D. (1993) Multimedia in Education: Arming Our Kids for the Future. *PC World* 11 (October, 1993).

McKenzie, J. (2007). Digital Nativism Digital Delusions and Digital Deprivation. *The Education Technology Journal, 17*(2).

McMullen, D. (1987). *Drills vs. Games - Any Differences? A Pilot Study.* (ERIC Document Reproduction Service No. ED #335355.)

Mitgutsch, K. (2007). *Digital play-based learning; A philosophical-pedagogical perspective on learning anew*. Paper presented at the Games in Action Conference, Gothenburg, Sweden.

Mitra, S. & Rana, V. (2001) Children and the Internet: Experiments with minimally invasive education in India. *The British Journal of Educational Technology, 32*(2), 221-32.

Moore, B. D. (2005). Neurocognitive outcomes in survivors of childhood cancer. *Journal of Pediatric Psychology, 30*(1), 51-63.

Oblinger, D. (2004). The next generation of educational engagement. *Journal of Interactive Media in Education - Special Issue on the Educational Semantic Web, 2004*(8), 1-18.

Okagaki, L., & Frensch, P. A. (1994). Effects of video game playing on measures of spatial performance: Gender effects in late adolescence. *Journal of Applied Developmental Psychology, 15*, 33-58.

Pannese, L., & Carlesi, M. (2007). Games and learning come together to maximise effectiveness: The challenge of bridging the gap. *British Journal of Educational Technology, 38*(3), 438-54

Paras, B., & Bizzocchi, J. (2005). Game, motivation, and effective learning: An integrated model for educational game design. *Digital Games Research Association 2005 Conference: Changing views- worlds in play, Vancouver, 16 - 20 June 2005*. Vancouver, British Columbia, Canada: Digital Games Research Association.

Paul, N. & Hansen, K. (2006). Disaster at Harperville: The modding of Neverwinter Nights to teach journalism students the strategic steps in information gathering. In E. Pearson & P. Bohman (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2006* (pp. 1954-59). Chesapeake, VA: AACE.

Pearson, E., & Bailey, C. (2008) *The Potential Of New Generation Games Consoles To Support Disabled Students In Education.* In Proceedings of World Conference on Educational Multimedia, Hypermedia and telecommunications 2008, Vienna, Austria, pp. 6199-205.

Pillay, H. (2003). An investigation of cognitive processes engaged in by recreational computer game players: Implications for skills of the future. *Journal of Research on Technology in Education, 34*(3), 336-50.

Pillay, H., Brownlee, J., & Wilss. (1999). Cognition and recreation computer games: Implications for educational technology. *Journal of Research on Computing in Education*, *32*(1), 203-16.

Pivec, M. (2008). Keynote Speech at eMapps final conference. "What we know about game based learning". Prague, 12 February 2008. http://emapps.info/index.php/eng/Events/Prague-Final-Conference

Pivec, M., Dziabenko, O., & Kearney, P. (2005). Game-based learning for e-inclusion, *AACE World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education (E-LEARN 2005)*. Vancouver, Canada.

Pivec, M., & Kearney, P. (2007). Games for Learning and Learning from Games. *Informatica 31* (2007), 419-23

Pivec, M., Koubek, A., & Dondi, C. (2004). *Guidelines on game-based learning*. Godina: Pabst Science Publishers.

Pivec, M., & Pivec, P. (2008). Playing to Learn: Guidelines for Designing Educational Games. *Proceedings of World Conference on Educational Multimedia, Hypermedia and telecommunications 2008* Vienna, Austria, 2008. (in press)

Prensky, M. (2001a). Digital Natives, Digital Immigrants. *On the horizon, 9*(5), 1-10.

Prensky, M. (2001b). Do they really think differently? *On the horizon, 9*(6), 1-10.

Prensky, M. (2006). *Don't bother me, Mom, I'm learning! : how computer and video games are preparing your kids for twenty-first century success, and how you can help!* St. Paul, Minnesota: Paragon House.

Project Tomorrow, (2008). Speak Up 2007 for Students, Teachers, Parents & School Leaders Selected National Findings - April 8, 2008. Retrieved from http://www.tomorrow.org/docs/National Findings Speak U 202007.pdf

Quinn, C. N. (1997). *Engaging learning.* Paper presented at the Instructional Technology Forum.

Ramsberger, P. F., Hopwood, D., Hargan, C. S., & Underhill, W. G. (1983). *Evaluation of a spatial data management system for basic skills education. Final phase 1 report for period 7 October 1980–30 April 1983*. Alexandria, VA: Human Resources Research Organization.

Redd, W. H., Jacobsen, P. B., DieTrill, M., Dermatis, H., McEvoy, M. & Holland, J. C. (1987). Cognitive-attentional distraction in the control of conditioned nausea in pediatric cancer patients receiving chemotherapy. *Journal of Consulting and Clinical Psychology, 55*(3), 391-95.

Reese, D. (2007). First Steps and Beyond: Serious Games as Preparation for Future Learning. *Journal of Educational Multimedia and Hypermedia* (2007) *16*(3), 283-300

Rice, J. (2007). New Media Resistance: Barriers to Implementation of Computer Video Games in the Classroom. *Journal of Multimedia and Hypermedia (2007) 16(3),* 249-61.

Rollings, A., & Morris, D. (2000). *Game Architecture and Design*. Scottsdale, Arizona: Coriolis.

Rosas, R. (2003). Beyond Nintendo: A design and assessment of educational video games for first and second grade students. *Computers & Education, 40,* 71-94.

Rosser, J. C., Lynch, P. J., Cuddihy, L., Gentile, D. A., Klonsky, J., & Merrell, R. (2007). The impact of video games on training surgeons in the 21st century. *Archives of Surgery, 142*(2), 181-86.

Ruben, B. D. (1999). Simulations, games, and experience-based learning: The quest for a new paradigm for teaching and learning. *Simulation & Gaming, 30*, 498-505.

Salen, K. (2007). Gaming Literacies: A Game Design Study in Action. *Journal of Educational Multimedia and Hypermedia* (2007) *16*(3), 301-22.

Salen, L. & Zimmerman, E. (2003). *Rules of Play, Game Design Fundamentals* (pp. 80-94). Cambridge and London: The MIT Press.

Seagram, R. & Amory, A. (2004). Designing Effective Stories for Educational Games. In P. Kommers & G. Richards (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2004* (pp. 162-167).

Shaffer, D. W. (2006). *How video games help children learn*. New York: Palgrave Macmillan.

Siemens, J. (2007). Digital natives and immigrants: A concept beyond its best before date. Retrieved from http://connectivism.ca/blog/2007/10/digital_natives_and_immigrants.html

Sorensen, B. & Meyer, B. (2007). Serious Games in language and learning – a theoretical perspective. *Digital Games Research Association 2007 Conference: Situated Play, Tokyo,* 559-66.

Sprague, D. (2004). Technology and Teacher Education: Are we talking to ourselves. *Contemporary Issues in Technology and Teacher Education, 3*(4), 353-61.

Squire, K., Barnett, M., Grant, J. M., & Higginbotham, T. (2004). *Electromagnetism supercharged!* Paper presented at the International Conference of the Learning Sciences 2004, Los Angeles.

Stevens, D. A. (2000). Leveraging technology to improve test scores: A case study of low-income Hispanic students, *International Conference on Learning with Technology*. Temple University.

Subrahmanyam, K., Kraut, R., Greenfield, P., & Gross, E. (2000). The impact of home computer use on children's activities and development. *Children and Computer Technology, 10*(2), 123-44.

Sweetser, P., & Wyeth, P. (2005). Gameflow: A model for evaluating player enjoyment in games. *Computers in Entertainment, 3*(3).

Tabula Digita, (2006). Gaming technology speaks students' language: Makes learning math as easy as 6 + [4W] – 6 = 24. Retrieved from http://www.dimensionm.com/how/CaseStudy_OcoeeMS.pdf

Thomas, P., & Macredie, R. (1994). Games and the design of human-computer interfaces. *Educational Technology, 31*(2), 134-42.

Thomas, R., Cahill, J., & Santilli, L. (1997). Using an interactive computer game to increase skill and self-efficacy regarding safer sex negotiation: Field test results. *Health Education & Behavior: the Official Publication of the Society for Public Health Education, 24*(1), 71-86.

Turnin, M. C., Couvaras, O., Jouret, B., Tauber, M. T., Bolzonella, C., Fabre, D., et al. (2000). Learning good eating habits playing computer games at school: A 2000 children evaluation. *Diabetes Research and Clinical Practice, 50*(1001), 239-39.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wainess, R. (2007). The potential of games & simulations for learning and assessment, *2007 CRESST Conference: The Future of Test-based Educational Accountability*. Los Angeles, CA.

Wartella, E. (2002). New generations – new media. *Nordicom Review, 1*(2), 23-36.

Wiebe, J. H., & Martin, N. J. (1994). The impact of a computer-based adventure game on achievement and attitudes in geography. *Journal of Computing in Childhood Education, 5*(1), 61-71.

Wylie, C. (2001). *Making sense: Relations between literacy, television use, computer use and other uses of children's time.* Paper presented at the Annual Conference of the New Zealand Association for Research in Education, Christchurch, New Zealand.

Yatim, M. (2008) *Usability and Fun Evaluation of a Game Authoring Tool* In Proceedings of World Conference on Educational Multimedia, Hypermedia and telecommunications 2008, Vienna, Austria, pp. 1504 – 1511.

Zagal, J.P., Rick, J. & Hsi, I. (2006). Collaborative games: Lessons learned from board games. *Simulation & Gaming. An Interdisciplinary Journal of Theory, Practice and Research. 37*(1), 24-40.

Appendices:

Glossary of game terminology

Action game:	This genre focuses on speed and physical drama with high demands on the player's reflexes and coordination skills.
Active learning:	Instructional activity involving students in educational process by design group discussions, debating, brainstorming, problem solving, case studies, role plays, journal writing, answering questions, etc. The benefits of the method include increased motivation and transfer of new information, improved critical thinking skills and sophisticated interpersonal skills.
Adventure game:	This genre focuses on puzzle solving within a narrative framework, relying on the player's ability to think logically.
Avatar:	An avatar is an interactive representation of a human figure in a games-based or three-dimensional interactive graphical environment.
Commercial game:	An overall term for video games that are sold through traditional distribution channels.
Computer game:	Often used as a generic term for electronic games, but for the purpose of this review a computer game is played on a PC or Mac computer, whereas a video game also refers to console games: Xbox, PlayStation, Wii, etc.
COTS:	An abbreviation used for "Commercial off the shelf" video games, typically recreational games bought in a retail store.
Drill-and-practice software:	Software that primarily relies on training a number of very specific skills by letting the user repeat the activity endlessly.
Educational games:	Games for learning are often imaginary (e.g. fantasy) interactive and immersive environments in which role play, skills rehearsal and other learning (e.g. collaborative or problem-based) may take place individually or in teams.
Game-based learning:	Instructional activity using video games in blended education for improving, accelerating and high-motivating of learning process.
Game console:	A game console is an electronic machine for playing dedicated video games. Game consoles may need a separate output device, e.g. a television or a PC monitor. The main input device is a games controller, e.g. hand controller, joystick.

Game design:	The visualization of the game concept, how the game will look, work, etc. Everything that exists in the game must appear and be described in the Design Document.
Game engine:	Each computer, video game or interactive application with synchronous graphics has a game engine. The game engine is the central software component, providing the underlying technologies. The engine greatly simplifies the task of games development, and often allows the game to be used on different platforms, e.g. different game consoles and PC operating systems.
Immersive world:	Immersive world is a term used in this review to mean simulations, games and other interactive, often 3D virtual spaces, or crossover spaces (e.g. between virtual and real).
Level-up:	The term used when a player achieves the required knowledge and skills to progress to the next level of the game. In multiplayer games, the higher levels are more difficult and the players also enjoy a higher social ranking in the player community.
MMO or MMORPG:	An abbreviation for Massively Multiplayer Online Role-Playing Game, in which a large number of players interact with one another in a virtual world.
Platform games:	Typically 2D games involve climbing ladders, jumping between platforms or jumping over objects in order to achieve a specific goal.
Role play:	Learning activity in which the student behaves in the way in which someone else would behave in a particular situation. Role-play allows student to practise in a safe situation.
RPG:	An abbreviation for role-playing games in which the participants assume the roles of fictional characters and collaboratively create or follow stories. Participants determine the actions of their characters based on their characterization, and the actions succeed or fail according to a formal system of rules and guidelines
RTS:	An abbreviation for real-time strategy games that refer to a combination of action and strategy, typically involving resource management and the waging of war.
Simulation:	Games where realism is the first priority. The player's ability to understand and remember complex principles and relations is paramount. Simulations represent real-world systems; they contain rules and strategies that allow flexible and variable simulation activity to evolve.
Strategy game:	Genre where the ability to deal with dynamic priorities is key.
Video game:	A generic term for electronic games that are designed for and played on a PC or Mac computer or on a console (Xbox, PlayStation, Wii) or handheld device (PSP, Nintendo DS, Gameboy).
Web-based Game:	Games that are played through a web browser and written in an Internet language such as HTML, Java, Perl, PHP, and Flash.

Useful internet links for educational game resources

http://www.socialimpactgames.com/

The goal of this site is to catalogue the growing number of video and video games whose primary purpose is something other than to entertain.

http://www.virtualworldsreview.com/info/categories.shtml

This site contains a comprehensive list of Virtual Worlds, both free and subscriber, for social and educational use.

http://www.supersmartgames.com/

Reviews, blogs, videos, and links to train-your-brain type games.

http://www.e-learningcentre.co.uk/eclipse/Resources/games.htm

A collection of selected and reviewed links to e-Learning and GBL resources.

http://www.shambles.net/pages/learning/games/research/

This website is designed to support international school communities (teachers, support staff, administrators, students and families) in 17 countries in South East Asia. The links points to their games research page.

http://www.swingame.com

SwinGame is a game development API and set of software development kits for students who are learning to program.

http://www.thinkingworlds.com

Thinking Worlds is a learning educational 3D game-authoring engine, free for educational use.

http://www.seriousgames.org/index2.html

The Serious Games Initiative is focused on uses for games in exploring management and leadership challenges facing the public sector in the United States.

http://www.sig-glue.net

SIG-GLUE: Special Interest Group for Game Based Learning in Universities, EU E-Learning Initiative.

http://simge.metu.edu.tr/fen/index.htm

Modification of popular commercial game Tomb Raider from METU, School for Educational TechnologyGame. Subjects cover Level-1: Photosynthesis, Level-2: Vitamins, Level-3: Fat, Protein, Carbohydrates. Free to download.

http://www.unigame.net/

An EU funded project for online role-play scenarios in universities.

http://www.gamedesigncampus.com/

Multi-user learning platform, *"The Training Room"*. Based on multi-user Flash technology and video conferencing. Scenarios available for schools, universities, and industry.

About the Authors

Maja Pivec

Maja Pivec, PhD, is Professor of Game Based Learning and e-Learning at the University of Applied Sciences FH Joanneum in Graz, Austria. During the years 1993-2004 she received numerous international grants and awards for her research in the field of innovative computer-based learning approaches and knowledge-

based systems. For her research achievements Maja received in 2001 the Herta Firnberg Award (Austria) in the field of computer science. In 2003 she was award a grant by the European Science Foundation for an interdisciplinary workshop organisation in the field of affective and emotional aspects of human-computer interaction, with emphasis on game-based learning and innovative learning approaches.

Maja is co-ordinator, scientific leader or partner in several EU or national funded projects and the editor and co-editor of several books published in the area of innovative learning approaches. She was guest editor of the *British Journal of Educational Technology*, Special issue on learning from games, May 2007. Her research work has been published and presented at more than 90 international conferences and publications, including many keynote and invited talks.

Maja is a member of the Laboratory for Decision Processes and Knowledge-Based Systems, University of Maribor, Faculty of Organizational Sciences, Slovenia, and is an international advisory board member of MJET – Malaysian Journal of Educational Technology. She is a Programme Committee member of GAMEON and FROG (Future and Reality of Gaming) conferences. Maja also reviews for the European Science Foundation and the *British Journal of Educational Technology* (BJET).

Maja continues to publish on a regular basis and actively teaches game-based learning through the successful course “Role-Playing the Computer Game Industry” – a tertiary level curriculum developed by the authors.

Maja’s full academic resume can be viewed on http://www.majapivec.com.

Paul Pivec

Paul Pivec has over 30 years experience in the computing industry and seven in academia. Originally a systems programmer, but with many years in networking and multimedia, Paul has owned and managed two multi-million dollar development companies with a customer base that included the New Zealand and Australian Governments, and multinational companies NCR and Hitachi. In the decade prior to the World Wide Web, Paul’s company *Trinet* was the first to bring multi-protocol compatibility to networks across Australia. As managing director and lead designer, Paul’s development team pioneered graphical interfaces for text-based management systems and subsequently sold the technology to AT&T.

With his experience in development and management, coupled with his entrepreneurial skills, Paul has successfully mentored start-up ventures such as the video game development company, Metia Interactive. From their initial conception of a commercial game idea, Paul coached them to the achievement of a national innovation award, and finally to bring their product to the world market through the Sony Interactive distribution channel. In recognition of his work, Paul has been an invited judge for the Australasian media and technology awards on successive occasions.

Having completed a Masters Degree in Game-Based Learning, and a Graduate Diploma in Higher Education, Paul is now completing a PhD to show the cognitive abilities gained from playing computer games. Now based in Europe, he is also combining his knowledge in pedagogy with his development skills to complete his latest project in multi-user game-based learning via the Internet. Paul still consults to game development companies both in Europe and down-under, and is actively publishing and presenting at conferences, as well as being guest lecturer on an ad-hoc basis.

Paul’s academic history and publication list can be seen at http://paulpivec.gdcradical.com.

Recommendations for decision makers and games producers

8. Recommendations for decision makers and games producers

All the observations made above indicate that the use of digital games in the classroom has something to offer to education systems. In order for this potential to be exploited and made more widely available, some recommendations are formulated here for the attention of political decision makers, the games industry and/or those involved in the educational world as a whole.

Evaluation of practices

Encouragement from the education authorities, the academic world and indeed the games industry itself, in favour of the development of evaluations of the impact of digital games on pupils' learning would meet a real need expressed by teachers. On the one hand, the teachers surveyed say that they would like to know more about the classroom use of digital games, and in particular to have access to studies of the impact of such practices. On the other hand, evaluation studies are also seen by the teachers as a means of shifting the opinion of parents, other teachers and school management as regards the use of digital games in the classroom.

Some studies and research projects are indeed already being carried out. Three experiments which are also action-research projects (*The Consolarium, Games Atelier* and *DANT*) are moreover presented as case studies in this final report. A literature review has also been carried out in the framework of our study and is presented in this final report. However, a large part of the research carried out does not concern the use of games in the context of school teaching; and it is precisely at this level that teachers' needs are situated.

In order to be useful, these evaluation studies would have to be rigorous and objective, and carried out by qualified research teams in which pedagogical expertise would be represented. In addition, to move beyond the level of generalities, precise areas of analysis would have to be investigated. For example, the following themes could be explored:

- The impact of each type of game on specific skills, in particular learning contexts
- The game elements responsible for the impact on specific skills
- The best way to manage pupils' different learning styles through games used in the classroom
- The impact of games-based learning on subject-specific skills
- The role of the teacher to ensure the potential of games in the teaching process is fully realised.

Re-examination of the potential of digital games

A (re-)examination or a discovery by the education authorities of the potential of digital games in the light of current knowledge of the functioning of the cognitive processes seems opportune.

The investigations that have been made do indeed show that digital games favour a way of learning that is particularly in tune with the modes of learning now regarded as effective.

The table below summarizes several major principles of learning that are now known and recognized. It relates them to the characteristics of digital games and the modes of use that they generate. The correspondences that emerge argue in favour of a 're-opening of the case'.

Knowledge of cognitive processes	Characteristics of digital games and modes of use
Intelligence is diverse (logical, linguistic, spatial, etc.) and distinctive	Games can be a complement or an alternative to traditional teaching aids (books, etc.) according to learners' individual preferences
Intelligence is dynamic and not divided into 'disciplines'	Games often implement a pluridisciplinary approach demanding a wide range of skills from the player
The pace of learning varies from one individual to another	Games allow for personalised learning (as many repetitions as are wanted, choice of tempo, etc.)
Awareness by the individual of the strategies he/she implements improves his results (meta-cognition)	Giving feedback to the player lies at the heart of many games
A learner who is actively involved in his/her learning improves his/her results	The game gives the player an active role
Learning among pupils is beneficial to all participants	Games often readily lend themselves to collective use and interchanges between players

In addition, curriculum objectives are increasingly being defined in terms of key skills. Among these are interpersonal, social and civic skills, enterprise, etc. The traditional pedagogical tools available to teachers (handbooks, set text books, etc.) are not necessarily designed to develop such skills. The digital games available which correspond to certain criteria endorsed by teachers may – in particular cases and given an appropriate pedagogical framework provided by the teacher – be an almost 'ready to use' solution.

Supporting experiments at grassroots level

The education authorities regularly support specific initiatives for innovation and modernisation of education systems with the aid of ICT: pilot projects, multimedia product development funds, training programmes, online resource banks, digital work environment, etc. Explicitly opening these structures to digital games, in the same way as to other pedagogical tools, would offer teachers and others working in education interested by this type of tool an appreciable support framework.

Likewise, some education systems organise training in change management and innovation for teachers and school managers. This training relies on (generally modest) financial support given to concrete initiatives conceived at 'grassroots' level, which enjoy a degree of freedom in the choice of projects undertaken. The development of initiatives in the area of digital games could be encouraged there.

Support for communities of practice in which teachers would be encouraged and helped to exchange tools, practices and evaluations would also respond to the needs identified.

More general support from local, regional or central education authorities for research, the launch of pilot projects and the dissemination of information about practices and their results would be a useful complement to the support mechanisms already mentioned. Specific initiatives to increase the awareness and information of parents would be welcomed.

Developing interactions between education and the industry

Cooperating when necessary with researchers and experts, teachers take part in the development and testing of sometimes complex digital games.

Some teachers who use digital games in the classroom express precise expectations regarding the characteristics they look for in the digital games available on the market.

Significant educational issues can be identified in the area of protection of the environment, climate change, management of water resources, etc. (to mention only those which have particular current salience). They could not fail to benefit from the development of educational tools that are attractive, meet the most demanding quality and technical standards and are capable of giving support to an actively pluridisciplinary approach on the part of the learners.

There are thus at least three strong arguments in favour of cooperation between teachers and games publishers in the framework of more or less large-scale projects. This cooperation would also represent an opportunity to be seized by an industry often associated with less edifying games.

Envisaging the European territory as an experimental laboratory

The use of digital games in the classroom teaching process is not common practice in any country. Some education systems are nonetheless witnessing the development of a larger number of projects and experiments in this area.

Moreover, conceptions of the role of digital games in the educational process also vary considerably from one country to another.

The development of a vast community of practice at the European level would make it possible to expand and enrich the range of experiments to which interested teachers, researchers and decision makers could have access, in terms of information, exchanges and even cooperation.

Such a community would also make it possible to develop large-scale projects with interested partners in the industry. The education system and its main participants, the pupils and teachers, would thus become involved in making a substantial contribution to the challenges of tomorrow, in terms of multicultural education, innovation and creativity.

ACKNOWLEDGEMENTS

European Schoolnet

Authors

- **Patricia Wastiau** (coordination), **Caroline Kearney**

Production

- **Alexa Joyce, Paul Gerhard, Maïté Debry**

Translation Coordination

- **Nathalie Scheeck**

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- **Henk van Zeijts, Keimpe de Heer**, The Netherlands

ANNEX 1: TABLE OF INTERVIEWED DECISION MAKERS AND NATIONAL EXPERTS

Country	Interviewee	Place and Date
Spain (1)	Joan-Badia, Director General of the Innovation in Education Department of Catalonia	Barcelona, 29/09/08
Spain (2)	Jordi Vivancos, In charge of ICT & Knowledge in the Innovation in Education Department of Catalonia	Barcelona, 29/09/08
Spain (3)	Joaquin Nunez Cabanillas, Assistant Director General of Training and Development of Teachers, Education Department of Catalonia	Barcelona, 29/09/08
Spain (4)	Begona Gros, Researcher at the Open University of Catalonia	Barcelona, 17/10/08
Austria (1)	Mag. Dr. MinR Reinhold Hawle, BMUKK - Austrian Federal Ministry for Education, the Arts and Culture	Brussels, 25/09/08
Austria (2)	Herbert Rosenstingl, Ministry of Social Affairs and Consumer Protection, Evaluation of PC and Console Games	Vienna, 03/10/08
Austria (3)	Christian Dorninger, School development and IT in Education, BMUKK - Austrian Federal Ministry for Education, the Arts and Culture	Vienna, 03/10/08
Austria (4)	Mag. Bernd Steiner, Subject Inspector for ICT, Steiermark Schools Inspectorate, School Quality/School Development	Graz, 25/09/08
Austria (5)	Alexander Nischelwitzer, Professor of Information Management, FH Joanneum University of Applied Sciences - Graz	Paris, 8/10/08
France (1)	Guy Ménant, National Education Inspector, Natural Sciences Group	Paris, 24/10/08
France (2)	Alain-Marie Bassy, National Education Inspector, Natural Sciences Group	Paris, 24/10/08

France (3)	Gilles Braun, Digital Resources, under the ICT in Education department of the Ministry of National Education	Paris , 24/10/08
Denmark (1)	Lilla Voss, Chief Adviser, Danish Ministry of Education	Odense, 4-5/11/08
Denmark (2)	Claus Berg, Cheif Consultant, Uni-C, the Danish IT Centre for Education and Research	Odense, 4-5/11/08
Denmark (3)	Lise Vogt, Danish Teacher and Subject Adviser, Danish Ministry of Education, Department for Primary, Lower Secondary and General Adult Education	Odense, 4-5 /11/08
Denmark (4)	Birgitte Holm Sørensen, Research Programme Director of Media and IT in a Learning Perspective, Professor, PhD	Odense, 4-5 /11/08
Denmark (5)	Simon Egenfeldt, CEO of Serious Games Interactive, Founder, PhD	Odense, 4-5 /11/08
Italy (1)	Gisella Langé, Ministry Inspector, Foreign Languages	Brussels, 3/11/08
UK (1)	Ben Williamson, Senior Researcher, Futurelab	Bristol, 27/11/08
UK (2)	Derek Robertson, National Adviser for Emerging Technologies and Learning, Learning Teaching Scotland (LTS)	Dundee, 18/12/08
UK (3)	Lynne Kilpatrick, Head of Computer Games, Department for Business, Enterprise and Regulatory Reform	London, 08/01/09
UK (4)	Wendy Parker, Head of Film, Fashion and Video Games, Department for Culture, Media and Sport	London, 08/01/09
Lithuania (1)	Vaino Brazdeikis, Centre for IT in education, Lithuanian Ministry of Education and Science	Brussels, 20/01/09
Lithuania (2)	Eugenijus Kurilovas Centre for IT in education, Lithuanian Ministry of Education and Science	Vilnius, 9/02/09
Lithuania (3)	Edita Sedereviciute, Chief specialist of basic and secondary education division, Lithuanian Ministry of Education and Science	Vilnius, 9/02/09
Lithuania (4)	Vilma Butkute, IMOTEC Project Consultant	Vilnius, 9/02/09
Netherlands (1)	Robert Ouwens, Dutch Ministry of Education and	The Hague, 11/02/09

	Culture	
Netherlands (2)	Henk van Zeijts, Education Programme Manager, Waag Society	Amsterdam, 11/02/09
Netherlands (3)	Wietse van Bruggen, Kennisnet	Zoetemeer, 17/02/09
Netherlands (4)	Wim Veen, Professor at the Delft University of Technology	Delft, 26/02/09
Netherlands (5)	Ineke Verheul, Researcher, University of Utrecht	Utrecht, 26/02/09

ANNEX 2: TABLE OF CASE STUDY PROPOSALS

Six case studies were selected from the table of proposals below, and are described in detail in section 4 of this report. They were selected on the basis that they represented a good range in terms of the type, purpose, age-group, scope, and subjects in which digital games are used in the classroom.

Country	Title	Type	Creator	Age range	Subjects	Purpose	Scope
Austria (1)	Zoo Tycoon 2	Business simulation	Microsoft	10 years upwards	German, English Biology	Team learning	One class in a secondary school
Austria (2)	The Movies	Business simulation	Lionhead Studios Ltd. & Microsoft	12 years upwards	German, English	Team learning	One class in a secondary school
Austria (3)	Global Conflicts, Palestine	Serious game	Serious Game Interactive DK	12 years upwards	Geography, Politics English, German	Team learning	One class in a secondary school
Denmark (1)	Sims2, Harry Potter; Patrician III; Samarost2	Commercial computer games	EA Electronic Arts, USA; Ascaron Entertainment, Germany; Amanita Design, Czech Rep.	11-15 year-olds	Danish language and literature (mother tongue), English, History (and cross-curricular learning, including Media knowledge).	Games as a genre, Media literacy, analysis of storytelling and construction of own written and oral contributions.	Højby School in Odense and Høng School in Kalundborg. (2 primary and lower secondary municipal schools in Denmark)
Denmark (2)	MissionMaker	Authoring game	Immersive Education, Oxfordshire, UK	12-16 year-olds (and older)	Languages and Media literacy (and cross-curricular learning, and ICT competencies in general)	Creating your own games, working and learning collaboratively and sharing knowledge. Peer learning.	2 Danish schools mentioned in case study Denmark (1), but also a range of schools in the UK, including Scotland.
Denmark (3)	Global Conflicts: Palestine	Serious game	Serious Games Interactive, DK	13-19 year-olds (and older)	History, Social Sciences, and Citizenship	Learning about global conflicts (challenging pupils to be critical and reflective citizens in a globalised world).	2 secondary schools in particular: Ordrup Gymnasium, and Skovshoved Skole, both north of Copenhagen.

France (1)	Logico-Floc	Strategy game	Floc Production Multimedia (group of teachers)	4-9 year-olds (and older)	Logic/Maths	To develop argumentation techniques and logical thinking skills	500 primary schools spread throughout France
France (2)	Big Brain Academy	Reflection game	Nintendo	11-15 year-olds	All subjects teaching scientific key competences	Diagnostic/remedial learning	1 lower secondary school
France (3)	Farm Frenzy	Simulation game	Big Fish	11-15 year-olds	All subjects teaching scientific key competences	Remedial learning	1 lower secondary school
France (4)	Kalypso	Business simulation	Arkhe International	17-18 year-olds	Economics and Management	Development of marketing and management concepts, and decision-making skills	Software mentioned in 2006 by the ministry responsible for this subject
Italy (1)	100 different games used in the IPRASE/DANT project	Games for Maths and Italian learning, specifically created for school context	Group of researchers	Primary school level	Maths and Italian language	Improvement of student achievement and motivation in Mathematics and Italian	3, 000 teachers and 6, 000 pupils from all regions of Italy (excluding Valle d'Aosta)
Netherlands (1)	Games Atelier	Location-based games. Students use mobile telephones, GPS and internet in order to make, play, share and review their own games.	Waag Society, in cooperation with Montessori Scholengemeenschap Amsterdam (MSA), Stichting Voortgezet Onderwijs Bijlmermeer (OSB), Dienst Maatschappelijke Ontwikkeling Gemeente Amsterdam (DMO)	Secondary school level	Various	To increase social involvement among young people by involving the physical environment in education and allowing students to both create and play location-based games.	A research project on the game "Frequency 1550" (the first game developed in the Games Atelier framework) involved 458 pupils from 20 classes in 5 schools in Amsterdam.
Spain (1)	Imperium III: Great Battles	Strategy - simulation	Electronic Arts Sports	9 years upwards	Ancient History, resource	Introduction of new content, content	Some secondary schools in Sant

	in Rome				management; Maths; Language	enrichment, Improvement of learning processes (cooperative work, problem solving, resource management, group dynamics)	Cugat (Spain)
Spain (2)	Restaurant Empire	Simulation	Total Games	8 years upwards	Maths (proportions and quantities, Language (menu elaboration, description of characters, vocabulary), Environment awareness (space distribution, decoration).	Project work, Resource management	Some primary schools in Terrassa, (Spain)
Spain (3)	Age of Empires	Strategy – simulation	Microsoft	8 years upwards	Environment awareness (History), Maths (Resource management, Space orientation), Language (Description of people and places, use of specific vocabulary)	Cross-curricular approach to the study of the Middle Ages using the internet as a source of information	Some primary schools in Barcelona (Spain)
Spain (4)	Creatures	Strategy – simulation	Creature Labs	8 years upwards	Environment awareness (changes in nature), modelling with a living creature, cycle of life (Scientific research), language (production of descriptive texts, issuing of simple	Cross-curricular approach to the subject of Evolution by means of using the game and internet as sources of information.	Some primary schools in Barcelona (Spain)

					orders), use of the Internet as a source of information, use of specific vocabulary in oral presentations		
UK (1)	MissionMaker	Authoring game	London Knowledge Lab & Immersive Education	11-14 year-olds	English, Media studies, ICT & Design, Technology	To explore design processes, teach input, process and output mechanisms in control technologies, develop critical media skills through the creation of creative media content - media literacy skills	
UK (2)	Playstation Portable platform (PSP in Education & Training Initiative)	Playstation Portable platform	Sony, ConnectED	11-14 year olds	Geography, Numeracy, Sport, Field Studies	Recording data in geography, sports and gym lessons, practising numeracy skills in isolated settings, developing visual communication skills of deaf children	
UK (3)	EduTeams multiplayer environment (EduTeams initiative)	Multiplayer game system	EduTeams	Primary and secondary school levels	Various	Problem-solving, team work, and communication skills	2 clusters of primary and secondary schools in Dundee
UK (4)	Nintendo DS Brain Training (Consolarium initiative)	Maths game	Nintendo	Primary school level	Maths	Improve numeracy	16 classes in primary schools across Scotland

Do digital games have a role to play in teaching? What is more crucial: their impact on pupils' motivation, or their potential to support personalised learning? What impact do they have on developing collaborative skills? What do teachers who use these games in their teaching think? What practices are already in place in the classroom? Do education systems within Europe approach these questions the same way?

This final report presenting the complete results of the study entitled ***How are digital games used in schools?*** approaches these questions from a balanced and neutral perspective. The study analyses the situation in eight countries: Austria, Denmark, France, Italy, Lithuania, the Netherlands, Spain and the UK. The study was launched in 2008 and is made up of several components: a literature review, a teachers' survey, case studies, interviews with education policy makers, and an online community of practice.

About the authors

Patricia Wastiau is Special Adviser for Studies and Development at European Schoolnet. She specialises in public policy analysis in education and knowledge-based policy-making. Previously, she was for ten years Director of Eurydice, the information network on education in Europe. She started her career as a researcher in social sciences. Since then she has developed extensive experience in European and international research projects and programmes in education and local development (Erasmus and Socrates programmes, OECD Local Employment Initiative). In recent years, she has been part of several expert groups and committees set up by the European Commission or the OECD.

Caroline Kearney currently works as an Education Analyst at European Schoolnet, concentrating on European studies and issues of knowledge management in the fields of ICT and innovation in education. Previous to this post she worked at Eurydice's Headquarters in Brussels. She holds a Masters with Distinction in Comparative Education, from the Institute of Education, University of London. She has had teaching experience in France, and in EU project management in Prague. Caroline has also undergone training at the European Commission in Directorate General for Education and Culture, in the unit for Lifelong Learning Policies.

European Schoolnet (EUN - www.europeanschoolnet.org) is a network of 31 Ministries of Education in Europe and beyond. EUN was created more than 10 years ago to bring about innovation in teaching and learning for its key stakeholders: Ministries of education, schools, teachers and researchers.

The Interactive Software Federation of Europe (ISFE – www.isfe-eu.org) was established in 1998 to represent the interests of the interactive software sector vis-à-vis the EU and international institutions. Thirteen major publishers of interactive software and thirteen interactive software trade associations throughout Europe have joined ISFE.