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Digital games in schools: Handbook for teachers

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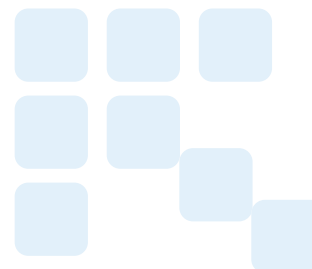


Digital games in schools

A handbook for teachers



Digital games in schools: A handbook for teachers complements the study *How are digital games used in schools?*, published in May 2009. Both publications have been written in the framework of European Schoolnet's Games in Schools project which began in January 2008 and ended in June 2009.



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1. Introduction



1.1 The purpose of this handbook

This handbook has been written in the framework of European Schoolnet's Games in Schools project which began in January 2008 and ended in June 2009. The project's aim was to analyse the current situation in eight countries (Austria, Denmark, France, Italy, Lithuania, the Netherlands, Spain and UK) with regard to games based learning. It is composed of various elements, including a synthesis and final report based on the results of a Europe-wide teachers' survey, case studies and interviews with relevant national policy makers, researchers and experts, as well as an online community of practice and finally the present teachers' handbook. The Games in Schools blog provides more information regarding European Schoolnet's project, and also provides links to the study's reports (<http://games.eun.org>).

This handbook is intended for teachers interested in using digital games in their lessons. It provides the necessary information to understand the educational benefits of digital games and to learn how to use them as educational and motivational resources. After reading this handbook, you should be able to make informed decisions on the choice and use of digital games in the classroom, and obtain all the benefits digital games can offer. This handbook is a practical guide aimed at providing you with theoretical and practical information. It is an introduction to the educational use of digital games and it provides references to useful resources such as articles, websites and books where you can find additional information.

1.2 Learning objectives

After reading this handbook, you should be able to:

- Understand the benefits of game-based learning.
- Be aware of successful use of digital games as a learning resource.
- Know digital games that you can use as a learning resource in the classroom and their expected learning benefits.
- Understand the differences between digital game genres and their learning benefits.
- Understand the requirements for the successful use of digital games for learning.
- Understand how to assess if a digital game is suitable for the classroom.
- Understand digital game ratings and standards.
- Know how to organize the classroom for a play session.
- Understand how to promote and apply healthy and safe gaming habits.
- Understand how to run a debriefing session after playing the game.
- Understand how to maximize the knowledge transfer so that information acquired in the game can be re-used at a later stage by pupils.
- Understand how to use digital games as a starting point to discuss sensitive issues.



2. Why use digital games for learning?

2.1 Change in the perception of digital games

Until recently, digital games were associated with many stereotypes and alleged to have negative effects on gamers' physical and mental health. However, later studies have shown that while digital games, played beyond a reasonable length of time, may have negative effects like any other excess, if good gaming habits are followed (eg. appropriate time, environment, moderation of online games, etc.) they can be considered a safe and fulfilling activity. The recent success of the *Nintendo Wii Fit* and *Nintendo DS* (e.g. *Brain Training*) illustrates some of the numerous ways in which digital games can impact positively on children's health and general well-being.

Lately, a new movement identified as *Serious Games* has emerged. This movement aims to use new gaming technologies for educational or training purposes. It investigates the educational, therapeutic and social impact of digital games built with or without learning outcomes in mind. This movement has emerged to meet the needs of a new generation of learners, often referred to as the *digital natives*, whose distinctive characteristics should be acknowledged in order to ensure successful learning outcomes and motivation on their part. This generation of learners was born after the 1970s and has been familiarized with digital technology from a very young age. They use digital devices frequently and ICT (Information and Communications Technology) has almost become

their native language, a language through which they communicate, express themselves and understand the world around them. Digital natives also play digital games extensively and are passionately engaged in social networks, sometimes in the form of virtual worlds (*Second Life, There*, etc.). They usually engage in activities that reward them for their perseverance, and as a result they expect the same level of reward from learning activities. On the other hand, some instructors and teachers have found it difficult to engage and motivate this generation to take part in traditional learning activities, perhaps because the format used for formal teaching has failed to match pupils' needs, preferences and expectations.

Digital natives' characteristics have been acknowledged by some educators who have understood that digital games could play an important part in education or training. These instructors have been using immersive environments and gaming technology in order to reach their students. This shift in teaching practices has been supported by the recent progress in gaming technology. It is now easier and less expensive to develop digital games, thanks to game engines, games middleware and *Mods* (modified versions of existing games), which make it possible for people with little or no programming background to develop digital games. As a result, instructors wishing to create an educational digital game can focus on its educational features rather than its underlying



technology. For example, *Game Maker*,^I a free, user-friendly game engine, is now used by teachers in several schools to create digital games that suit their class plan or to improve pupils' programming skills. Digital game technology is also widely used to provide training in a motivating

yet realistic environment for a wide range of trainees including surgeons, soldiers and fire fighters. For example, virtual environments such as *Second Life*^{II} have been used to teach biology to students or to train firefighters. More recently, the immersive features of *Second Life* have been coupled to Moodle, a Learning Management System (LMS), to produce Sloodle. Sloodle is a virtual environment where participants can navigate, explore and attend virtual classrooms. It facilitates communication and collaboration between learners and teachers, regardless of geographical constraints.

2.2 The benefits of digital games

Digital games include several implicit educational benefits. They can develop cognitive, spatial and motor skills and help improve ICT skills. They can be used to teach facts (e.g. knowledge, recall, rote learning or memorization), principles (e.g. cause and effect relationship) and complex problem solving, to increase creativity or to provide practical examples of concepts and rules that would be difficult to illustrate in the real world. They can be particularly useful to perform experiments that could be dangerous in real life such as the use of hazardous chemicals.

Despite their instructive features, not all digital games are built with learning objectives in mind; however, they all possess intrinsic learning qualities that challenge and foster learners'

I *Game Maker* is available at: <http://www.yoyogames.com/make/>

II *Second Life* is available at: <http://www.secondlife.com>



cognitive abilities. Digital games are based on the premise that players need to learn, to memorize, to collaborate, to explore or to obtain additional information to progress further in the game. Playing is learning and one of the main advantages of digital games is their ability to let players learn in

a challenging environment, where they can make mistakes and learn by doing. These types of environments might be particularly suited to pupils who are pragmatically minded. These pupils might prefer to go through the process of experimenting, instead of regurgitating information. Such an experience could help them to better understand some concepts that they might otherwise perceive as complicated or boring.

Digital games promote genuine collaboration between users, and are, to some extent, similar to collaborative learning environments or collaborative working environments, where participants share information and learn from each other (e.g. Computer Supported Collaborative Working environments). Multiplayer digital games develop both competition and collaboration, by motivating players to join teams (or guilds) and to compete against other teams. For example in MMORPGs (Massive Multiplayer Online Role-Playing Games), players can create teams, share information through text and voice and learn by observing other players. Beginners can learn from their peers and improve their skills.

Digital games can have an emotional impact on players, increasing their self-esteem (provided that proper monitoring is applied) and enabling them to engage in social activities. Playing can have a calming effect on participants who, as in other entertaining activities (e.g. watching films), feel a wide range of emotions, but in a safe and controlled environment. Emotions experienced during play can vary through joy, empathy, anger,

frustration or triumph. This succession of emotions tends to keep the players immersed. Furthermore, studies have shown that emotions can help the memorization process, especially if the emotional content or tone of the material to be learned matches the emotions of the learner. Because they induce different emotions in the players, digital games might help them to remember facts more vividly and so assist the cognitive process. Digital games can increase players' self-confidence. This is achieved by keeping success within their reach (i.e. *winnability*), making sure that the learning curve is suitable to their skills and providing feedback on their progress.

2.3 From CBT (Computer-Based Training) to digital games for learning

Since the emergence of the first CBT system, computer technologies have evolved significantly, and so have learning theories. The design of educational systems has been greatly influenced by trends in educational psychology and instructional design. For instance, when the first CBT systems were released, they were based on a number of questions and predefined answers allowing for little interaction with the user. Subsequent systems have included more flexibility by incorporating tutoring systems. Tutoring systems added the ability to monitor learners' progress and to adapt pedagogical strategies

dynamically. Although these systems were effective, their development costs were sometimes perceived as prohibitive, partly because they were based on advanced Artificial Intelligence (AI). Later on, the use of simulation matched the need for learners to experiment with their mistakes, through a constructivist approach to learning, an approach that prioritizes learning *by doing*. Recent learning environments are based on virtual reality and built with collaboration in mind. They allow participants to learn from their experience but also to learn from their peers. Recent popular digital games such as MMORPGs or virtual communities (e.g. There^{III}, Second Life) inherently include these aspects. Because collaborative learning occurs naturally in these environments, they have been considered to support traditional teaching methodologies.

2.4 Digital games and the cognitive process

Educational theories and Instructional Design can help to create learning material and to ensure that the learning objectives are achieved by the learners. Such theories have been used to design school curricula and training programmes. Amongst existing learning theories, different approaches can be applied to ensure successful learning outcomes. Most educational theories fall into one of the following categories: *cognitivist*, *behaviourist* and *constructivist*. In *behaviourist*

III There is an online virtual environment where the user can take part in social activities. It is available at: <http://www.there.com>



approaches, subjects are not directly responsible for their learning activities; instead, they are conditioned to react to a stimulus. In *cognitivist* theories, subjects possess an *internal map* (knowledge), which external events will require them to update. In these theories the emphasis is

on the underlying cognitive process. Several well-known theories have been established under the cognitivist movement, such as transfer effect, whereby learning can be affected by previous knowledge. Finally, in *constructivist* theories, subjects learn by interacting with their environment and peers. This involves a process of trial and error and the learners' ability to interpret their past and present experiences to update their knowledge.

Because they were initially designed for entertainment, digital games are not all built based on Instructional Design theories. However, some of them intrinsically implement some well-known pedagogical concepts. For example, digital games usually include high intensity of interaction, specific goals, a continuous feeling of challenge, and a sense of engagement; these concepts have been associated with successful learning environments by Norman (1993¹). To some extent, digital games feature all approaches – behaviourist, cognitivist and constructivist. However, whereas early educational software placed an emphasis on the first two theories, recent digital games, due to their complexity and their open-ended and collaborative nature, encourage a constructivist approach to learning. In digital games, players can elaborate new theories and hypotheses, test them and readjust their knowledge and skills accordingly. New digital games, which include a 3D environment, advanced AI and realistic physics engines, offer a simulation-like environment that reacts to players' actions in a highly realistic manner.



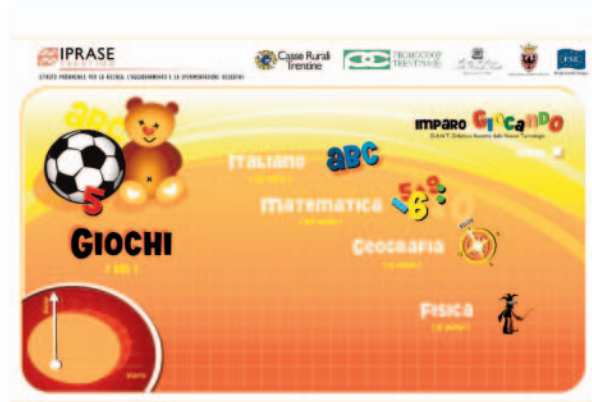
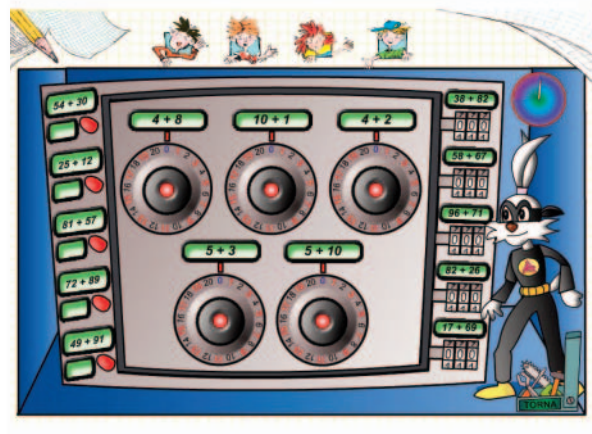
In term of cognition and learning process, digital games can be analysed through well-known models such as Carroll's minimalist theory (1990², 1998³), Vygotsky's Zone of Proximal Development (ZPD) (1978⁴) or Kolb's basic learning model (1975⁵). For example, the basic learning model

illustrates the process of accretation whereby students modify their internal map (or knowledge) based on the information and feedback obtained from their previous actions. They successively go through active experiments, concrete experiences, reflective observations, abstract conceptualizations

and back to active experiments. To some extent, the cycle of learning events experienced in digital games can be compared to Kolb's learning cycle: the players experience something discordant or a failure (failure to win); they subsequently need to reflect and identify the cause of the failure. Following this analysis, they formulate hypotheses on the cause(s) of the failure, plan actions that might help them to overcome the problem and then test and assess their hypotheses. Likewise, according to Vygotsky's Zone of Proximal Development (ZPD), learners should be assisted with scaffoldings and be progressively made more and more independent. As they improve their skills, less and less help is provided. Learners' independence and meta-cognitive skills are improved gradually. This principle can also be found in digital games, which offer an easy learning curve and are usually forgiving in the first levels, so that players can progressively familiarize themselves with the game's mechanics and become proficient. However, players need to learn new skills to succeed, and, to some extent, to take responsibility for learning. This ability of digital games to engage children and motivate them to learn in order to succeed is by far the most interesting feature that could help instructors to make learning a more engaging and motivating activity.

2.5 Digital games and motivation

One of the foremost qualities of digital games is their capacity to motivate, to engage and to immerse players. Digital games include a rich



variety of auditory, tactile, visual and intellectual stimuli that make them both enjoyable and, to some extent, addictive. During play, users are immersed in a state of flow (Csikszentmihályi, 1990⁶), a state in which they can forget about their surroundings and become totally engaged and focused on the task in hand. In this state, provided that they possess sufficient skills, players will strive to achieve their goal, regardless of the challenges

encountered. Players' motivation can be triggered or hindered by many different factors such as the game play, the graphics, the interface or the game genre. Players' behaviours in digital games depend on their personality and aspirations. Therefore, the relevance of the reward offered in the game might differ across players. Whereas some players value exploration, other might prefer highly complex scenarios, where more strategic skills are required; some of them will enjoy very simple games with a linear scenario that necessitates a short time of play to succeed. Cultural background and gender might also influence the motivation to play games.

2.6 Successful applications of digital games

Digital games have already been used for training, educational or therapeutic purposes. Some of the most common uses of serious games are listed below.

2.6.1 Military and firefighter training

In the military sector, MMORPGs are used not only to recruit soldiers but also to teach them strategic skills. For example, *America's Army*^{IV} has been used to recruit soldiers and as a training resource by the American government. It is now available as a commercial digital game, which has been successful.

IV <http://www.americasarmy.com>

V <http://www.msnbc.msn.com/id/6687019/>

2.6.2 Fitness, mental and physical health

The technology available for 3D-based digital games has made it possible to create highly realistic environments and simulations. This remarkable level of detail has been used to cure post-traumatic stress or phobias (Emmelkamp et al., 2001^V). When they are immersed in a safe but realistic environment, patients can learn to cope with their fears while feeling in control. Digital games have also been used to relax patients before surgery so as to reduce their apprehension^V. *Nintendo Wii* and *Wii Fit* have recently been employed and assessed for their potential to improve health and fitness and it was shown that, when used as part of a balanced lifestyle, these consoles can help to improve fitness and general health (ISSA, 2007⁸). Digital games have also been employed successfully for adults with chronic illnesses.

2.6.3 Learning by creating digital games

Experiments have been conducted in which students were required to create their own digital games using a game engine. These initiatives made it possible for students to understand programming principles, while collaborating with their peers. For example, the game engine *Game Maker* is used in several schools. It consists of

intuitive drag and drop tools to create 2D and 3D digital games which can then be uploaded onto the publisher's website^{VI} and made available for download. This type of development tool benefits technical and collaborative skills and the creation of online communities.

2.6.4 Mobile development and augmented reality

Using augmented reality, it is possible to obtain relevant information on one's surroundings through a digital device (e.g. helmet or mobile phone). Due to their popularity, handheld devices have been combined with augmented reality in projects where mobility and location were significant factors for learning activities. For example, in *Savannah*^{VII}, a strategy-based adventure game, children use their mobile phones, and have to successfully adopt strategies followed by lions to survive^{VIII}. Similarly, in the *Museum Augmented Reality Quest* (MARK), players are equipped with a handheld game console. They visit a museum and are asked to complete tasks and challenges. The handheld console is used to provide them with additional information on artifacts found in the museum and to interact virtually with them (Schmalstieg and Dieter, 2007⁹).

VI <http://www.yoyogames.com>
 VII <http://www.experientia.com/playful/creating-the-user-experience-of-an-educational-and-strategy-based-adventure-game/>

2.6.5 Raising awareness

Digital games have been adopted to raise awareness and to help discuss topics that can be taboo, such as pollution, environmental threats, sexual health or bullying. For example, in the recently developed digital game *Global Conflicts: Latin America*^X, the player impersonates a journalist who conducts an investigation to uncover the causes and consequences of industrial pollution in South America. Likewise, in the digital game *Darfur is Dying*^X, players impersonate refugees in Darfur camps. Through their journey, players are led to understand the horror of genocide.

2.6.6 Learning history

Digital games have been used in primary and secondary schools to illustrate concepts in science, history or geography. For example, the digital game *Civilization III* was used in American schools to teach history (Squire, 2004¹⁰). Similar experiments were carried out in Danish schools (Egenfeldt-Nielsen, 2007¹¹) using Europa Universalis II.

VIII <http://www.futurelab.org.uk/projects/savannah>
 IX <http://www.globalconflicts.eu/>
 X <http://www.darfurisdying.com/>



3. Choosing the appropriate game

Digital games can be delivered in various formats including CD-ROMS, DVDs, or online. The following sections will help you as a teacher to understand the different game genres, their key features and educational benefits.

3.1 Taxonomy of digital games and associated benefits

Before choosing a game, it is important to understand the different genres available and how to identify them. The following list classifies and describes different game genres. Their potential learning applications and benefits are underlined.

- **Shooters (and shoot 'em ups):** In these games, players have to win by shooting their opponents. Shooters can be static or scrolling. In static shooters, the battlefield is restricted to the size of the screen, whereas in scrolling shooters, only part of the battlefield is displayed, and the screen scrolls horizontally or vertically. Beat 'em ups also belong to this category. In these games the players need to fight opponents. Shooter games place emphasis on reflexes and coordination, rather than strategy. *Recent digital games based on this genre, such as Re-Mission^{XI} or Immune Attack^{XII}, have been used to introduce basic concepts of immunology or cancer treatment.*

- **Bat and ball games:** In these games, players use a bat to hit a ball. One of the first digital games based on this principle was *Pong*^{XIII}; since then, many variations have flourished, including *Breakout*, a game in which players have to hit a ball that travels across the screen and strikes and destroys bricks. *Some educational games have been based on this genre, including 10 Finger BreakOut*^{XIV}, *a game that teaches typing skills.*
- **Platformers:** In these games, players move through an environment where they need to progress to platforms (hence the name). Mario was one of the most popular platformer games of its generation. *Platformers are usually based on hand-eye coordination, and educational versions of these games have been developed to teach geography (e.g. Mario is Missing*^{XV}*), reading (e.g. Mario's Early Years: Fun with Letters) or typing skills (e.g. Mario Teaches Typing).*
- **Puzzles:** In these games, players have to solve a puzzle to progress further in the game. The gameplay usually occurs within a static screen. Tetris is one of the most popular puzzle games. Puzzle games are essentially based on strategy. *Educational versions of puzzle games have been developed to teach mathematics (e.g. PrimeTime Adventure or Rocky's Boots*^{XVI}*).*

XI <http://www.re-mission.net/>

XII <http://fas.org/immuneattack/>

XIII <http://www.pong-story.com/atpong2.htm>

XIV <http://www.caiman.us/scripts/fw/f955.html>

http://www.nintendo8.com/game/628/mario_is_missing/

XV <http://prime-time-math-adventure.taylor-clark-software.qarchive.org/>

XVI <http://www.warrenrobinett.com/rockysboots/>

- **Mazes:** In these games, players have to navigate through a maze and are chased by enemies that they have to avoid. These games usually offer a view from above and require strategy, forward planning skills and reflexes. Pacman is one of the most successful Maze games. *An educational version of Pacman called PacWriter^{XVII} has been created to improve typing skills.*
- **Sport Games:** These games simulate popular sports such as football, golf or basketball. *They are available in 2D or 3D. They require coordination and strategy, especially if the player has to manage a team.*
- **Racing Games:** In these games, players take part in a race, driving a car, a motorbike or a spaceship. *Racing Academy^{XVIII} is based on this genre and is used to increase learners' familiarity with engineering concepts. Research has shown that this digital game has helped pupils to understand engineering notions (Sandford and Williamson, 2004¹²).*
- **RTS (Real Time Strategy):** These games are essentially based on strategy. The players control both the economic and military aspects of an army or population and have to take fast strategic decisions. *In a study by Jenkins and*

Squire (2003¹³), it was shown how Civilization III, a popular RTS game, could be used in schools to help pupils understand geography and history.

- **RPG (Role Playing Games):** In these games, players impersonate a fictional character. *This character has several features that can evolve through play, such as health, strength or other skills. For example, SimCity^{XIX} is a popular RPG game that makes it possible for players to build cities and to understand urban management.*
- **FPS (First Person Shooters):** In these digital games, players see the world through the eyes of the character they are impersonating (first person view) and need to eliminate enemies in order to progress further. These games can be played individually or collectively. They generally include violent content. However, if the game is played within a team, these games can promote collaboration. *Mods of these games have been created for educational purposes. For example, DimensionM^{XX} is an FPS developed to help and encourage the learning of mathematics. It has been shown that this game had a significant positive impact on learners' academic performance and motivation (Kebritchi et al., 2008).*

XVII <http://www.caiman.us/scripts/fw/f2998.html>
XVIII <http://www.futurelab.org.uk/projects/racing-academy>

XIX http://simcity.ea.com/play/simcity_classic.php
XX <http://www.dimensionm.com/>



- **MMORPG (Massive Multiple Online Role-Playing Games):**

MMORPGs are a variation of RPGs, in which a large number of players interact in an online virtual world. *These digital games are a valuable basis for collaborative and exploratory activities.*

- **Educational versions** of existing board games or TV game shows have also been released. *For example, Stu's Double Jeopardy^{XXI} is based on the well-known TV show Jeopardy and can be used in classrooms to teach any topic in an interactive manner.*
- **Adventure games:** *In these digital games, the gameplay is based on story telling. Players navigate through a complex world, collecting objects and overcoming challenges until they reach the final goal. This game genre, initially based on text, has evolved to include 2D (e.g. King's Quest^{XXII}) and 3D graphics (e.g. EverQuest^{XXIII}).*

The following table includes possible educational uses of existing commercial digital games.

XXI <http://jeopardygame.wordpress.com/>

XXII <http://www.vintage-sierra.com/kingsquest.php>

XXIII <http://everquest.station.sony.com/>



Table 1: List of some popular commercial games and their learning benefits

Game	Developers / Publishers	Learning Benefits
Age of Empires II	Ensemble Studios/ Microsoft Games Studios	History, strategy and resource management
Age of Mythology	Ensemble Studios/ Microsoft Games Studios	Mythology, strategy and resource management
Bioscopia	Viva Media	Zoology, cellular biology, human biology, botany and genetics
Chemicus	Viva Media	Chemistry
Civilization III	Firaxis Games	Planning and problem solving
Making History: The Calm and the Storm	Muzzy Lane	History, World War II, economic management and negotiation
Nancy Drew: Message in a Haunted Mansion	Her Interactive	Investigation, deduction and puzzle solving History, geography, mathematics, logical reasoning, strategy, resource management and reading
Oregon Trail	The Learning Company	
Pharaoh	Vivendi Universal	Egyptian civilization, strategy and management
Reader Rabbit	The Learning Company	Reading and spelling
Return of the Incredible Machine Contraptions	Vivendi Universal	Problem-solving skills and physics
Roller Coaster Tycoon 3	Frontier Developments/Atari	Management, kinetic and potential energy
Toontown	Sony Creative Software	Social collaboration
Where in Time is Carmen Santiago	The Learning Company	Discovery and logic
World of Warcraft	Blizzard Entertainment	Collaborative learning
Zoombinis Logical Journey	The Learning Company	Logic and algebra

Whereas the previous games were not initially built with educational objectives, other games, referred to as *serious games*,^{XXIV} were built to teach, train or raise awareness. They can be news games (journalistic games reporting on current events), simulation games (games using strategy and simulating several aspects of reality) or *organizational-dynamic games* (games used to teach the dynamics of organizations).

XXIV The definition of 'serious games' can vary

Table 2: List of some popular educational games and their learning benefits

Game	Developers / Publishers	Learning Benefits
Global Conflict: Palestine	Serious Games Interactive	Understand the Palestinian conflict
Global Conflict: Latin America	Serious Games Interactive	Understand the causes and consequences of industrial pollution in South America
Timez Attack	Big Brainz	Improve algebra skills
Virtual Leader	Simulearn	Understand leadership
3D World Farmer	3D World Farmer Team	Understand the difficulties faced by farmers in Africa
DimensionM	Tabula Digita	Improve algebra skills
America's Army	UBI Soft	Military training
Darfur is Dying	mtvU/Reebok Human Rights Foundation/International Crisis Group	Understand the living conditions in Darfur refugee camps
Food Force	Deepend/Playerthree for United Nations World Food Programme	Learn about disaster relief, food logistics and delivery
Re-Mission	HopeLab	Understand how to help and improve the life of people living with cancer
Revolution SimPort	The Education Arcade Tygron	Learn about the American Revolution Understand the challenges involved in constructing large infrastructures
Power Politics	Kellogg Creek Software/Cineplay	Understand the processes involved in the US presidential campaign
Immune Attack	Federation of American Scientists/Escape Hatch Entertainment	Understand how the immune system works
Missing	LiveWires Design	Understand how to surf the Web safely
Virtual U	Enlight Software	Understand the management of American universities
DoomeD	DESQ/University of Wolverhampton	Learn about science
Cyber Budget (French version only)	Paraschool/French Minister for Economy, Finance and Industry	Understand how to manage public finances

3.2 Understanding digital games' technical requirements

It is difficult for teachers to find software that is suited to their computer lab and to pupils' home computers. High computer technical specifications, such as processor speed, graphic card or screen resolution, can sometimes prevent the use of digital games in schools where computers are not up-to-date. Whereas commercial off-the-shelf digital games may require high technical specifications, those available on the Internet in the form of Flash^{XXV} or Java^{XXVI} Applets may impose fewer constraints, other than the installation of plug-ins (which are often installed by default on the computer). Digital games available on the Internet can be played within the browser window. They usually offer a very intuitive interface and require less processing power. They are generally available in the form of mini-games, with challenges that can be solved quickly. They also use relatively simple interaction techniques, and are therefore suitable for people with little or no experience of digital games.

Before choosing a game for the classroom, you should check the specifications of the computer room and try to answer the following questions:



XXV <http://www.adobe.com/flash/>
XXVI <http://www.java.sun.com/>

- Which operating software is required for the game?
- How much RAM (Random Access Memory) is recommended for the game to function properly?
- How much hard drive space is needed to install the game?
- Does the game need to be played over a network or an Internet connection?
- What type of input device is needed to interact with the game (joystick, keyboard or mouse)?

Answering all these questions will help you to assess if the digital game you wish to use is suitable for the school's computers. Not taking these features into consideration at an early stage could result in a frustrating experience for the pupils (e.g. lack of responsiveness or inability to go further in the game). The type of input used in the game should be assessed based on pupils' age and skills. For instance, answering questions by selecting the correct option with the mouse might be more suitable than typing the solution. The latter option requires a higher level of proficiency in spelling. Pupils' home machine specifications should also be considered. Enabling pupils to play the game at home in their spare time will help them to become more familiar with the interface and improve their skills. In this case, you will need to make sure that the technology required for the digital game is available in most computers used by pupils at home.

3.3 Understanding digital game rating and standards

Beyond practical considerations, you should determine if the content of the digital game is suitable for the pupils in terms of age and content. This choice can be guided by existing rating standards. For example, PEGI^{XXVII} (Pan European Game Information) is a European digital game rating system. It is supported by most game publishers and developers in Europe. This rating system helps to ensure that the content of a game is suitable for the target audience. It is a voluntary system used in 32 European countries, but is only enforced in two (Finland and Norway).

PEGI consists of two levels of information to guide the consumer. First, a logo that represents the minimum recommended age (the age categories are: 3, 7, 12, 16 and 18).



A series of game content descriptors, designed as icons, are displayed on the back of the game box and indicate, where required, the nature of the content.

There are 8 icons, depending on the type of content.

XXVII <http://www.pegi.info>



Violence: game contains depictions of violence



Bad Language: game contains bad language



Fear: game might be frightening or scary for young children



Sex: game depicts nudity and/or sexual behaviour or sexual references



Drugs: game refers to or depicts the use of drugs (including alcohol and tobacco)



Discrimination: game contains depiction of or material which may encourage discrimination.



Gambling: game encourages or teaches gambling.



Online: game can be played online

More information on PEGI is available on the official website^{XXVIII}. This website makes it possible to find a game^{XXIX} according to the country in which it is published, the age rating, the game genre or the publisher.

XXVIII <http://www.pegi.info/en/index/id/33/>

XXIX http://www.pegi.info/en/index/global_id/505/




3.4 What to look for in a digital game: Testing the game

Once you have found a suitable game to support your lessons, you should play-test the game to check if the content is appropriate for the pupils and suitable for the topic taught. Also, be sure to complete all training tutorials and read relevant

material beforehand. The following points should be observed:

Technical considerations:

User interface: The interface should be clear, intuitive and easy to use. Some children might stop enjoying the digital game because they find it



difficult to perform common tasks such as navigating through the menus or moving the main character.

Saving and loading the game: The game should enable players to save the current level and to resume the game at a later stage. This will be particularly useful if the computer rooms are only available for short periods of time.

Audio: If the game features sounds, a mute button should be available.

Customization: You should check if it is possible to customize the game (e.g. character, colour, scenario or level of difficulty). Customization makes the gaming experience more personal and keeps players challenged (e.g. by level of difficulty).

Contextual considerations:

Age group: The activities and type of skills required for the game should be suitable for the targeted age group.

Language: The level of the language used should be adequate for the age group.

Time: You need to estimate the time required to complete challenges to ensure that pupils will have enough time to finish the game levels and benefit from their educational features. Completion time will vary across games. Whereas mini-games available on the Internet are usually designed to be completed relatively quickly, adventure games or RPGs might require several hours or days to be completed. For the latter, it is good practice to plan the playing session over a week or more, so that pupils can learn at their own pace and

become familiar with the mechanics of the game. In addition, games can also be used after school as homework.

Taking account of people with disabilities:

You should check if the digital game accommodates people with disabilities (see next chapter for more information on digital games designed for this audience).

Network games: If the game is played over the Internet and involves interaction between participants (e.g. text or chat), care should be taken to prevent bullying and to use mechanisms to detect and condemn such behaviours. It is very important for children to feel safe while playing digital games, and to know that they can report unacceptable behaviour if it is encountered.

Pedagogical considerations:

Learning curve: The game should use an easy learning curve, allowing players to make mistakes at the start.

Educational content: The game content should illustrate the topics taught. Even if the content is not closely related to the curriculum, it should provide a clear and simplified representation of some of the concepts taught.

Clear objectives: Teacher should ensure that the objectives of the game are stated clearly, so that children know exactly what they are required to do. Frustrating situations can arise from vague instructions. In this case, children might feel stuck, because they don't know how to progress further in the game.



Clear progression: The teacher should check whether the progression of the player is displayed at all times in the form of a score or progression bar. This will help children to have a positive attitude to their performance, and show them that their actions have an influence on their progression. This should motivate players to take responsibility for their learning activities.

Feedback: Feedback provided to players should be gentle. Verbal guidance or hints can help to maintain their focus.

Opportunities for collaboration and group work: It is good to use digital games that enable players to take part in collaborative activities.

Assessment and follow-up: Software that tracks pupils' progress enables you to analyse areas that are misunderstood and where more work is required. Not all software includes this feature, but some of it is SCORM-compliant (Sharable Content Object Reference Model) and can be integrated into a Learning Management System (LMS). A Learning Management System will make it possible for you to follow the progress of your pupils and to identify areas where more attention and work is required.

Opportunities for creativity: You should check whether the material included in the digital game can encourage pupils' creativity by enabling them to make and share objects.

Help: A Help section should be available and comprehensive. If possible, you should print it and have it ready for pupils before they start playing the digital game.

3.5 Taking account of children with disabilities



3.5.1 Games for visually impaired people

Some recent games accommodate visual impairment, and can be mainstream digital games and audio games.^{XXX} AudioGames.net^{XXXI} and Blindstick.com^{XXXII} provide information on audio games and blind-accessible games.^{XXXIII}

Educational digital games suitable for people with impaired vision include *Terraformers*,^{XXXIV} *Talking Typing Teacher*^{XXXV} (typing skills), *Braille Twister*^{XXXVI} (learn Braille) and *Quality Quizz*^{XXXVII} (trivia game). When using mainstream digital games, you need

XXX Audio games are digital games that can be played based only on audio cues.

XXXI <http://www.audiogames.net/>

XXXII <http://www.whitestick.co.uk/>


XXXIII <http://www.audiogames.net/listgames.php>

XXXIV <http://www.terraformers.nu/>

XXXV [http://www.braillebookstore.com/view.php?C=](http://www.braillebookstore.com/view.php?C=Talking+Typing+Teacher+for+Windows)
Talking+ Typing+ Teacher+for+Windows

XXXVI <http://www.mynebulous.com/comp145/>

XXXVII [http://www.braillebookstore.com/view.php?C=](http://www.braillebookstore.com/view.php?C=Quality+Quizz+for+Windows)
Quality+ Quizz+for+Windows



to check whether buttons can be read aloud and if other information can be delivered through audio cues. To help reading onscreen information in the digital game, screen readers and screen magnifiers can be used.

3.5.2 Games for people with an auditory disability

To make auditory information available to people with an auditory disability, closed captioning is sometimes available in digital games, enabling people to see the meaning of auditory information such as text or sound effects. Popular commercial digital games that feature closed captions include *Zork: Grand Inquisitor*, *Half-life 2* and *SiN Episode 1: Emergence*. Some other commercial digital games make extensive use of text for dialogues, feedback or tutorials and are therefore also suitable for people with an auditory disability. These games^{XXXVIII} include: *Zoo Tycoon*, *The Sims*, *Chariot of War*, *Age of Mythology*, *Civilization*, *Nancy Drew*, *Pharaoh*, and *World of Warcraft*.

3.5.3 Games for people with a learning disability

Although players with a mild disability will be able to play most mainstream digital games, some of these games might not be suited to specific disabilities. For example, people with dyscalculia^{XXXIX} might find

it problematic to play games that involve basic mathematics (e.g. counting). Likewise, people with dyslexia have difficulties playing digital games where the information is delivered essentially through text. People with ADD/ADHD^{XL} might find it difficult to play games with no immediate feedback or games that require prolonged periods of play. You should therefore test the game and identify issues that might arise depending on pupils' learning disabilities. Some digital games have been specifically designed to help particular learning disabilities, and might be used in the classroom. For example, *Brigadoon*^{XLI} is a digital game based on *Second Life*. It is designed for people with autism and Asperger syndrome to help them to socialize and to interact with other people.

3.5.4 Games for people with a physical disability

For people with physical disabilities, digital games can be made accessible by choosing a dedicated controller and also thanks to mechanisms provided in the game itself or by the operating system. For example, *slow-motion gameplay* enables players with a physical disability to go through part of the game where the action is intense. It is important for players to be able to customize the controls and to use external controllers. *One-switch* digital games are suitable for players with severe physical disability because they only require one or two buttons^{XLII}.

XXXVIII These games also have an educational benefit.

XXXIX People who have difficulties in handling everyday maths functions.

XL Attention Deficit [Hyperactivity] Disorder.

XLI http://braintalk.blogs.com/brigadoon/2005/01/about_brigadoon.html

XLII Several one-switch digital games can be found on

<http://www.oneswitch.org.uk>



4. Conducting a play session

4.1 Organizing a play session

4.1.1 How to organize the class and the classroom

Once you have tested the game and decided to use it as an educational resource, you will need to identify the scenario that you think will be most beneficial to support your students. Several key points should be considered:

Technical and contextual points:

- If the digital game uses sound and if the activities are not of a collaborative nature, you should ensure that pupils use headphones.
- Depending on the type of game and on the learning objectives, you may need to create groups. This will be very effective to engage children in discussions or collaborative activities.
- Take breaks: it is good practice to encourage children to take regular five-minute breaks every 45 minutes.
- Make sure that the light in the room is sufficient and adequate. This can avoid occurrences of epilepsy seizures.



Pedagogical points:

Before the lesson:

- Identify learning objectives.
- Identify what part of the game or levels might best support the learning objectives.
- Print the list of objectives and help section (or booklet) of the game to give to the students.

During the lesson:

- Begin by explaining the objectives of the session.
- Demonstrate the game and explain how common tasks are performed (e.g. accessing Help, navigating through menus or moving the character).

4.1.2 Promoting good, safe and healthy gaming habits

Like any other form of activity, digital games should be used wisely and appropriately. Therefore, you as teachers, and also parents and pupils, should be informed of good gaming habits. Following these guidelines should help to ensure that digital games do not negatively affect children's physical and mental health.

Teachers and parents need to **regulate the amount of time** during which children play. Children might be asked to set the length of the play session themselves. Some children may find it hard to stop playing but this could be due to the fact that they are trying to avoid boredom. It is good practice to encourage children to play different types of game genres to challenge them in different ways. For example, children might alternate between action games, strategy games and puzzles.

Children should be encouraged to **exercise regularly** in addition to playing digital games, except of course if these digital games include exercising. In addition, it is important to communicate with them and take the time to listen to their success in the adventure they have undertaken. They should also be made aware of potential issues and risks such as bullying and be informed of the resources they can contact to complain.

Finally, information should be provided to your teacher colleagues, parents and course-board members on the pedagogical process, the preparation and the learning objectives of game-based-learning. This information should be given before and while using the game.

4.2 Evaluating and strengthening pupils' knowledge through a debriefing session

4.2.1 General considerations to conduct a debriefing session

Digital games can promote many different cognitive skills; however, some of the aptitudes needed to make a connection between the game and the curriculum, such as reflection, observation, prediction or theory-building, are not always built into the digital game. It is therefore necessary to include a debriefing session through which pupils will have an opportunity to reflect on the content of the game, and to share the knowledge that they have acquired. The debriefing session can also be used to ask children to explain how they feel about the digital game and describe their achievements or frustrations. Debriefing sessions are a way to make a link between the game and the learning outcomes. During a debriefing session, you should encourage pupils to relate to their experience and to discuss what they have learned while playing. You might ask students to compare the different methods or techniques presented in the digital



game, or to describe the different solutions they have tried, and identify the ones that have worked for them. If the game is used to discuss sensitive issues, the characters of the story can be used as the starting point for discussion. Pupils might be

asked to comment on the behaviour of some characters, the consequences of their acts and possible actions to solve the issues. After running the debriefing session, you should summarize the different points brought forward in the discussion

and the learning objectives of the session. You should also ask pupils to summarize what they have learned from the digital game. This will help to formalize and memorize the concepts and ideas introduced. The issues raised during the debriefing session can then be referred to during formal classes.

The strategy for the debriefing session is summarized below:

- Review learning objectives.
- Ask pupils to answer questions stated at the start of the session.
- Ask pupils to relate to their experience.
- Initiate discussions.
- Make the link between the game experience and the learning objectives.
- Summarize findings.
- During formal classes, refer to findings made while playing the game.

4.2.2 General understanding of the game

After playing a digital game, pupils should have a good understanding of its goal and objectives. They need to understand the purpose and challenges raised by the game. Asking pupils the following questions will help you to assess their general understanding of the game:

- Where and when does the scene take place?
- What is the goal of the game?
- Who is the main character?
- What are the main challenges faced by the main character?
- What do you need to do to be successful in this game?
- What items do you use to help you pursue your quest?
- What prevents you from achieving your goal? (e.g. characters, events, etc.)
- What are the main issues raised by the game?
- Who are the main protagonists?

4.2.3 General understanding of the issues raised by the game

When you have ensured that pupils have understood the general goals of the game, it is time to check that they understand the underlying ideas or topics introduced by the game so that a link can be established between the game and the topic taught. For this purpose, you can ask the following questions:

- What is the main topic of the game?
- Do the events that take place in the game remind you of something you know, or something you have heard of from your friends, family or on TV?
- Why do you think this topic is important?
- What did you learn from this game?



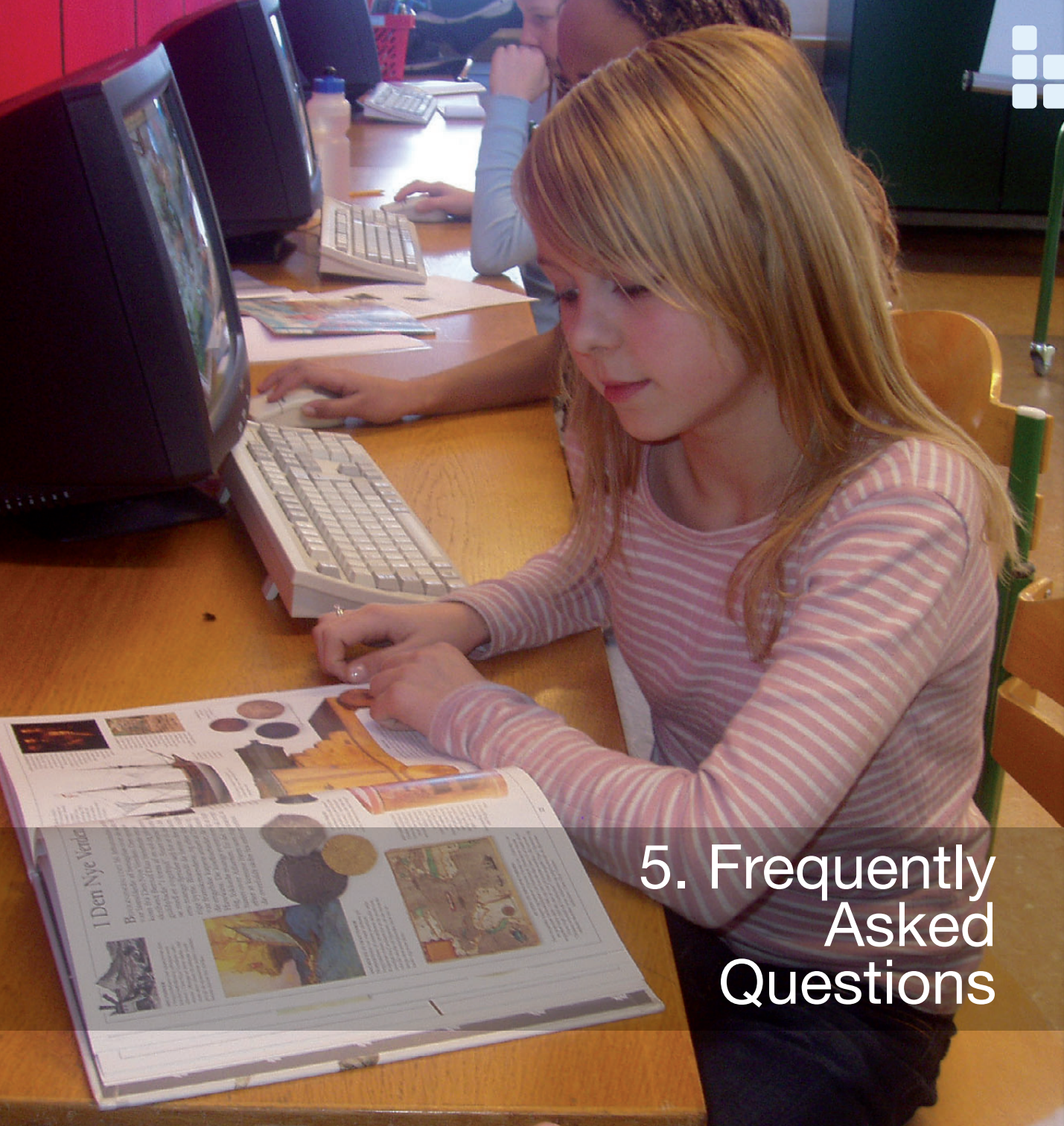
4.2.4 Linking game concepts to real life

While pupils might understand the game's goals, it is particularly important that they understand key principles in the digital game that mirror real life concepts. You might especially ask them to explain key actions in the game and their consequences. For example, if you have chosen to use the game *Global Conflicts: Latin America* to explain industrial pollution in South America, you could ask the following questions:

- What are the causes of pollution in South America?
- What are the effects of industrial pollution on people living near maquiladoras?
- What would happen if all maquiladoras were closed-down?

4.2.5 Factual information

Before starting the game, you should give a list of factual information that pupils need to gather while playing. After the game, they will need to show that they have remembered important locations, names or dates from the game.



5. Frequently Asked Questions

Are digital games bad for pupils' health?

If children are taught healthy and safe habits and if a balance is maintained between play and other activities, digital games can be a fulfilling activity with little or no risk.

How can I make sure that the digital game I have chosen is appropriate for my pupils?

You need to check the game rating and to play the game yourself to assess whether it is appropriate in terms of language, violence and educational content.

How can I make sure children will learn from the game?

Not all digital games are built with educational objectives in mind. However, some can prove successful in teaching or in introducing basic principles. The most important part is the debriefing session, because it enables you to make a link between the game content and the learning objectives.

Our machines are very old and can't run games supplied on CD-ROMS. What are our options?

If your machines' specifications are inadequate for games supplied on a CD-ROM, you might try Java or Flash-based games. These games (especially those using Flash) are lightweight and not so processor-intensive.

We have a very low budget for digital games. How can we obtain good-value games for learning?

Whereas COTS (Commercial-Off-The-Shelf) games can be expensive, many other digital games with educational benefits can be used for free. Alternatively, digital games can be rented.

How can I know whether children will enjoy the game?

It is very difficult to know exactly what game children will or won't like. However, a good starting point is to read the reviews provided in online forums and magazines.



Can digital games replace traditional classes?


No. Digital games cannot replace traditional classes. However, they can considerably help to involve and to motivate children. Some children might find some topics very difficult to understand until they experience them through play, and digital games can provide them with this opportunity. In this regard, digital games do not replace traditional classes but instead provide an additional way to reach children and enable them to understand topics that they might otherwise find too complicated.

Is there any evidence that digital games can help learning?

Yes. Several reports have shown that digital games can be used effectively in schools to improve both learning and motivation. The resource section lists some of these reports.





A photograph of a woman with dark hair tied back, wearing a white turtleneck sweater, leaning over a young boy with short dark hair wearing a dark green t-shirt. They are both smiling and looking towards the left side of the frame. The boy is sitting at a desk with a brown chair. The background is a plain, light-colored wall.

6. Resources for teachers

6.1 Further reading on the use of digital games for learning

6.1.1 Books on the learning benefits of digital games

Gee, J. P. (2008).
What Digital Games Have to Teach Us About Learning and Literacy. New York & Basingstoke: Palgrave Macmillan.

Prensky, M. (2006).
Don't Bother Me Mom – I'm Learning!
St. Paul, MN.: Paragon House Publishers.

Shaffer, D. W. (2008).
How Computer Games Help Children Learn.
New York & Basingstoke: Palgrave Macmillan.

6.1.2 Reports on the use of digital games for learning

European Schoolnet (2009). Games in Schools^{XLIII}. Final report available at: http://games.eun.org/upload/gis-full_report_en.pdf.
Synthesis report available at: http://games.eun.org/upload/gis-synthesis_report_en.pdf

Futurelab (2007). Teaching with Games. Final report available at: http://www.futurelab.org.uk/resources/documents/project_reports/teaching_with_games/TWG_report.pdf

ISSA Press Release (2007). Digital games May Offer Health Benefits, Experts Suggest. Available at: <http://www.issaonline.com/press-room/downloads/exertainment.pdf>

BECTA (2006). Computer Games in Education: Report. Available at: <http://partners.becta.org.uk/index.php?section=rh&rid=13595>

BECTA (2006). The Becta Review: Evidence on the Progress of ICT in Education. Available at: <http://publications.becta.org.uk/download.cfm?resID=25948>

Teem (2002). Report on the Educational Use of Digital games. Available at: http://www.teem.org.uk/publications/teem_games_in_ed_full.pdf

^{XLIII} Of particular interest are the case studies providing concrete examples of the use of games in European classrooms, described in brief in the synthesis report and in detail in the complete final report.

6.2 Web portals for digital games for learning

<http://www.ramogames.com/>
<http://CoolMath4kids.com>
<http://www.arcademicskillbuilders.com/>
<http://www.learninggamesforkids.com/>
<http://www.vocabulary.co.il/>
<http://www.vocabulary.co.il/>
<http://www.SpellingCity.com/>
<http://hotpot.uvic.ca/>
<http://www.BrainPOP.com>
<http://www.interactivestuff.org/sums4fun/colquiz.html>
<http://kids.nationalgeographic.com/Games/>
<http://funschool.kaboose.com/>
<http://www.prongo.com/games/>
<http://www.thekidzpage.com/learninggames/index.htm>
http://www.sheppardsoftware.com/web_games_menu.htm
<http://www.gamequarium.com/>
<http://www.kidsgames.org/>
<http://www.theproblemsite.com/>
<http://www.funbrain.com/>
<http://www.primarygames.com/>




Glossary of terms

ADD	Attention Deficit Disorder
ADHD	Attention Deficit and Hyperactivity Disorder
AI	Artificial Intelligence
CBT	Computer Based Training
GBL	Game Based Learning
FPS	First Person Shooter
LMS	Learning Management System
MOD	Modified version of a Digital game
MMORPG	Massive Multiplayer Online Role Playing Games
RAM	Random Access Memory
RPG	Role Playing Game
RTS	Real Time Strategy Game
SCORM	Sharable Content Object Reference Model



- 1 Norman, D. A. (1993). *Things that Make Us Smart: Defending Human Attributes in the Age of the Machine*. New York: Addison-Wesley.
- 2 Carroll, J. M. (1990). *The Nurnberg Funnel*. Cambridge, MA: MIT Press.
- 3 Carroll, J. M. (1998). *Minimalism beyond the Nurnberg Funnel*. Cambridge, MA: MIT Press.
- 4 Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.
- 5 Kolb, D. A. and Fry, R. (1975). Toward an applied theory of experiential learning. In C. Cooper (ed.) *Theories of Group Process*, London: John Wiley.
- 6 Csíkszentmihályi, M. (1990). *Flow: The Psychology of Optimal Experience*. New York: Harper and Row.
- 7 Emmelkamp, P. M. G., Bruynzeel, M., Drost, L., van der Mast, C. A. P. G. (2001). Virtual Reality treatment in acrophobia: a comparison with exposure in vivo. *Cyberpsychology & Behavior*. June 2001, 4(3): 335-339.
- 8 ISSA (International Sports Sciences Association) Press Release (2007). Digital games May Offer Health Benefits, Experts Suggest. Available at: <http://www.issaonline.com/press-room/downloads/exertainment.pdf>
- 9 Schmalstieg, D. and Wagner, D. (2007). Experiences with Handheld Augmented Reality. *Proceedings of the 6th IEE and ACM International Symposium on Mixed and Augmented Reality (ISMAR 2007)*, 3-15.
- 10 Squire, K. (2004). *Replaying History: Learning World History through Playing Civilization III*. Available at: <http://website.education.wisc.edu/kdsquire/dissertation.html>

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- 11** Egenfeldt-Nielsen (2007). *Educational Potential of Computer Games*. London: Continuum.
- 12** Sandford, R., and Williamson, B. (2004). Racing Academy: A Futurelab prototype research report. Available at: http://www.futurelab.org.uk/resources/documents/project_reports/Racing_Academy_research_report.pdf
- 13** Squire, K. and Jenkins, H. (2004). Harnessing the power of games in education. *Insight*, 3 (5), 7-33.
- 14** Kebritchi, M., Hirumi, A. and Bai, H. (2008). The Effects of Modern Math Computer Games on Learners' Math Achievement and Math Course Motivation in a Public High School Setting. Available at: http://www.dimensionm.com/docs/UCFResearch_Brief_June_202008.pdf



This handbook has been written in the framework of European Schoolnet's Games in Schools project which began in January 2008 and ended in June 2009. The project's aim was to analyse the current situation in eight countries (Austria, Denmark, France, Italy, Lithuania, the Netherlands, Spain and UK) with regard to games based learning. It is composed of various elements, including a synthesis and final report based on the results of a Europe-wide teachers' survey, case studies and interviews with relevant national policy makers, researchers and experts, as well as an online community of practice and finally the present teachers' handbook.

This handbook is intended for teachers interested in using digital games in their lessons. It provides the necessary information to understand the educational benefits of digital games and to learn how to use them as educational and motivational resources. After reading this handbook, teachers should be able to make informed decisions on the choice and use of digital games in the classroom, and obtain all the benefits digital games can offer.

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.

