

A Comparative Study of Digital Game Platforms for Educational Purposes

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Abstract—Digital games have gradually been accepted as learning tools in schools and colleges. They can be run or distributed on several platforms including DVD-ROMs or CD-ROMs for personal computers; consoles for television-based systems; game specific handheld consoles; and, handheld units such as personal digital assistance (PDA), portable computers or mobile phones. This paper reports the features, components, and advantages of these digital platforms for educational uses. It is expected that this comparative study will be useful for digital game manufacturers, educators and users who are interested in the development and use of this digital media for education purposes.

I. INTRODUCTION

Digital games today have become an important part of most children's leisure activities and increasingly being integrated as an important part of children culture as a whole. In the past, these kinds of games have been considered as a disruption to the class activities, such as school work and playing during recess. Today, however, researchers, teachers and designers of learning resources [1], [2], [3], [4] have increasingly accepted this kind of media and believe it can be used to complement children's learning. Digital games can play on many platforms including personal computers on-line or off-line; on game consoles which use television as the display; on handheld consoles which run software on cartridges or memory devices; and on handheld units such as mobile phones which use the machine's communication channel to downloaded software [5].

This paper considers digital games in two broad categories: non-portable and portable platforms. Generally, non-portable refers to computer games on PCs and game consoles which usually need to be placed on a particular location. These platforms also need addition game input devices such as keyboard, mouse, trackball, joystick and game controllers. All these non-portable platforms are normally powered from the mains electrical power. On the other hand, portable refers to those handhelds, handsets or mobile devices which are smaller in size, being able to be carried around and powered by some forms of battery. Nowadays, the handheld and mobile devices are more advanced with increasing variety of functionalities and user-friendliness. Some handheld and mobile phone vendors [6], [7], [8] have also begun to implement and support educational game software for classroom learning. Hence, in order to utilise digital games for teaching and learning,

teachers and school administrators have to decide from the many alternative digital game platforms that which is the most suitable for a learning environment. It has to be recognised that these game platforms have different features, components, advantages and limitations comparing to one another. It is the purpose of this paper to have an objective comparison between the characteristics, product features, functions, as well as the educational uses of these digital game platforms. It is hopeful that this comparative study can be used as a guideline for educators and stakeholders in the decision making process in choosing the most suitable game platforms for the teaching and learning situation.

II. FEATURES OF DIGITAL GAME PLATFORMS

The digital games platforms can be divided into two broad categories: non-portable and portable platforms as shown in Figure 1. In general, non-portable refers to digital games platform on PC and game consoles which typically necessitate to be used at a particular location. Portable refers to digital games platform on handhelds, handsets or mobile devices which have portable and be able to be carried around.

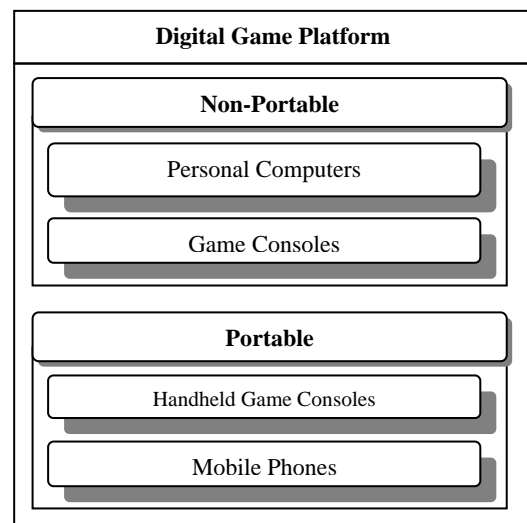


Figure 1: Classification of Digital Game Platform: Non-Portable and Portable Game Devices

Even though each digital game platform has its unique features, there are some components in common and the comparisons of these digital game platforms are shown in Tables 1, 2, 3, and 4.

Table 1: Main Components of Non-portable Platforms

Components	PC	Game Consoles
Core Unit	Computer	Console
Input	Mouse, Keyboard	Joystick
Output	Monitor	TV
Storage	Hard disk, Optical Disks	Optical Disks
Networking	LAN,WI-FI	LAN,WI-FI

Table 2: Main Components of portable Digital Game Platforms

Components	Handheld Game Consoles	Mobile Phones
Core Unit	Handheld Console	Mobile Headset
Input	Directional pad, Stylus	Qwerty, Stick, Stylus
Output	LCD, TV	LCD
Storage	Optical Disk, Cartridge	Flash Memory
Networking	WI-FI	Cellular Network, WI-FI

Table 3 Comparison of the Features in PC and Game Consoles

Features	PC	Game Consoles
Cost	More costly	Likely cheaper
Upgrading	More convenient	Limited
Educational Content	Most	Less
Add-on Device	More Convenient	Convenient
Connectivity	Convenient	Convenient
Main Power	Household electricity	Household electricity

Table 4 Comparison of the Features in Mobile Phones and Handheld Game Consoles

Features	Handheld Game Consoles	Mobile Phones
Cost	Likely cheaper	Likely cheaper
Upgrading	Limited	Limited
Educational Content	Moderate	Moderate
Add-on Device	Convenient	Inconvenient
Connectivity	Convenient	More convenient
Powered by	Battery	Battery

III. COMMERCIAL DIGITAL GAME MANUFACTURERS

At the present time, more commercial game industries are tentatively making inroads into the interactive learning market [5]. Some have produced software game-based learning applications while others provide support and funding for innovators or developers to create game applications for learning. This section provides snapshots of data on the manufacturers in each digital game platform covering PC, Game Console, Handheld Game and Mobile Game. Some game vendors who support game software for teaching and learning purposes are also presented.

A. The PC Manufacturers

The PC market has been considered to be one of the strongest segments in the video game industry [9]. PC games cover a wide range of styles and most PC games can be categorised into specific genre, theme or game setting. It can be observed that PC games include action shooters, multiplayer, strategy games and many more based on a specific genre and/ or theme of game. Well known manufacturers of PC game included: Microsoft Game Studios, Electronic Arts, id Software, Interplay Productions, Westwood Studios, Activision, 3DO, Blizzard Entertainment and Atomic Games. Randy Hinrichs, a researcher of the Microsoft Research Group for Learning Science and Technology, is collaborating with a number of colleges and universities. Their most notably initiative is the MIT's iCampus project [10]. This involved simulation technologies that support activity-based learning, discovery learning, and game-based learning. Microsoft Research and academics also use video game to promote the courses and to lure the students into the computer science discipline [11].

B. Console game manufacturers

A console manufacturer is a company that produces and distributes video game consoles. Some of the most recognised console manufacturers include: Atari, Microsoft Corporation, Nintendo Company, Sega, and Sony Computer Entertainment Incorporated. However, currently there are three major popular platforms Xbox (Microsoft), PS3 (Sony) and Nintendo (Nintendo). There are not a lot of typical educational games produced from console manufacturers. Some educational entertainment from Sega likes "the toy that thinks it's a computer" in the forms of interactive storybook. Microsoft Xbox produced educational games but it is just some kinds of 'personal trainer' or brain training programs.

C. Handheld Game Manufacturers

Handheld game consoles include: Nintendo DS (NDS), Game Boy, Game Boy Advance, Sega Game Gear, Pokemon mini, NeoGeo Pocket, Atari Lyns, Pandora, GP2X/GP32, Gizmondo and PlayStation Portable (PSP) N-Gage. Sega is the first in producing commercial games that apply explicit learning under the title "Typing of Dead" (2000) [5]. The aim

of this game is to teach typing skills in an entertainment context. Another famous learning product is Nintendo's Brain Training with Dr Kawashima. This title encourages the users to improve their cognitive skill. PlayStation Portable (PSP) also gains much attention in UK. One of the schools in Birmingham uses PSP to support teaching French, History and Geography lessons [6]. At the present time, there are two main handheld game manufacturers competing with each other - Nintendo and Sony.

D. Mobile Phone Manufacturers

Mobile phone is a portable electronic device using mobile voice or data communication over a network of specialised base stations known as cell sites. Current mobile phones may support many additional services, and accessories, such as SMS for text messaging, email, packet switching for access to the Internet. Additionally, the services include camera with video recorder and MMS for sending and receiving photos and video, Bluetooth, infrared, GPS and gaming. The top five mobile phone vendors are Nokia, Samsung, Motorola, Sony Ericsson, and LG. In terms of education applications, many mobile vendors are supporting projects of both e-learning and m-learning. Nokia provides comprehensive e-learning with multiple delivery methods such as self study, virtual classroom, and blended solutions. Nokia has recognised and supported several innovators who produced those software applications in mobile learning and e-learning environments. Sony Ericsson also has its project called Ericsson Education Dublin on mobile learning. The initiative is funded by European Commission in Brussels [12].

In brief, a number of digital game platform manufacturers are beginning to focus on education market either directly or indirectly. They have produced games for learning as well as supporting game software programmers in mobile-learning in one way or another.

IV. EDUCATIONAL USES OF DIGITAL GAME PLATFORMS

There are numerous research-based indications that digital games have some potential in teaching and learning. As a result, the use of digital games in teaching, learning and education gains more attention in many places [13], [14], [15], [16].

Most games implemented in the classrooms are PC-based. However, recently other digital games platforms such as handheld and mobile game devices are used in trials for classroom learning.

Comparing PCs and Consoles for education, the PCs have the benefits that there is available a wide range of such software. Playing game on PC platform can be supported by a range of different input devices and are more commonly used by children with physical and communication needs. On the other hand, game consoles are less common in school classrooms. The main reason for this is a lack of educational or learning software of relevance or of acceptable quality [1].

However, console-based can also be used for learning purpose. One of the most outstanding educational console-based game software is *Lightspan*. The software is curriculum-based and it was developed for the PlayStation Console [1].

Handheld games such as PlayStation Portable (PSP) and Nintendo Dual Screen (NDS) have also been widely used as learning tools in many places including the schools in UK and Japan [13], [14], [15] due to their small size, portable, easy and simple to use, and their variety of functions. In terms of teaching support, instructors can prepare contents in audio or video and provide course guidelines and assignments, or discussion points with reference to the text-books. Owing to the ease of use of these handheld devices, teachers who are unfamiliar with modern technology could be relieved of the pressure from using such devices. Parents can also support their children's learning by going through some of the education resources available on internet. Such applications can be downloaded and there are well prepared learning materials on the subject topics.

The other popular digital game platform for educational use is mobile phone. Currently mobile phone is not only just a communication device, but it has also emerged as an educational tool for learning. The benefits of mobile phone include small size, portable, fit into the pocket, be able to be carried around everywhere, be nearly always on, regarded as friendly and personal devices, and cheap and easy to use. There is an attempt to use this device as a learning tool in schools in many places. The University of Bradford in UK, for example, is aiming to improve teaching science subject through mobile games. Professor Excell from the University's School of Informatics [17] explained: "*As science is perceived as a 'hard subject', we are looking at finding ways to explain these 'difficult to understand' concepts through digital media. We are researching into the delivery of educational content through mobile devices and game technologies. We see these as important areas to investigate due to their proliferation in today's youth culture*". The University of Bradford will join institutions in France, Ireland, Finland, Italy, Belgium and Hungary to improve scientific teaching within schools. Nilsson [16] has also conducted her research on games and learning by experimenting with computer games and mobile technology in Swedish school. In France, Wapedue School in Monntpellier uses this device for education and bills itself as a "nomadic school" [2]. In China there are several companies, including the BBC, exploring the area. Department of Electrical and Electronics Engineering in the University of Hong Kong also developed a mobile learning platform to enhance the quality of teaching and learning with advanced communication technologies. In Japan, most Japanese phones are already extremely advanced and run many different kinds of applications and services. Mobile learning and using games to teach in Japan have gone beyond merely speculating about these channels for learning [18].

Additionally, in terms of online game, the internet has become a predominant channel of communication and access [1]. Most of the digital game platforms mentioned above is

able to connect to internet for downloading educational games. The Children Go Online Survey (UKCGO) 2005 [5] found that 71% of young people have access to the internet via a home computer, 38% via mobile phone, 17% via digital television and 8% via a computer game console.

V. CONCLUSIONS

Computer games are a growing part of the modern culture. New generations have become familiar with the opportunities afforded by playing with, experimenting in and exploring digital game environment. In the 21st century, digital games are no longer only in the domain of home entertainment; they have increased being incorporated into the classrooms of schools and colleges. Most digital games in classroom are played on Personal Computers. However, researches show that other game platforms such as handheld game console and mobile system have been trial for use in the classrooms in many places. [6], [7]

In term of educational uses, PC has been mostly used as a games machine, even if people purchased for other tasks. Game consoles are less commonly used for school learning although there are some game console manufacturers produced educational games as personal trainer or brain training programs. Handheld game console such as Nintendo DS and PlayStation Portable have been increasingly accepted and used as trial learning tools in many places [13],[14] while some top mobile phone vendors such as Nokia and Sony Ericsson support several developers who produce software applications for e-learning and mobile learning.

It is hopeful that this comparative study of features and educational uses on digital game platforms will be beneficial for both digital game manufacturers and educational sectors. The increasing use of digital game in educational purpose might be an indicator for manufacturers to realise that education sector is one of the largest markets in the future. In the same time, education sectors can use the comparison of product features for their future consideration to implement suitable game platforms for learning environments.

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