Use of Computer and Video Games in the Classroom

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ABSTRACT
This paper examines the use of "pure" computer and video games in classrooms. It reports the findings of an ongoing informal survey of how and why such games are used as an integrated part of formal classroom learning. The paper presents a number of examples of the use of such games, and tries to determine likely trends in their use in such an environment. Of significance is an examination of the obstacles that teaching staff encounter in attempting to use such software during lesson times, and how some staff have overcome these obstacles.

Keywords
Computer games, video games, school, classroom, Xbox, PC, GameCube, Playstation, PS2

INTRODUCTION
The last few years have seen a significant increase in the community of researchers studying computer and video games. These studies encompass a wide range of investigations into topics as diverse as the reasons for games appealing to so many people, the effects on the individual and society of the emergence of this entertainment-based culture, and ways in which games can accurately (or realistically) model the real world. Various academic articles, journals (online and/or peer reviewed), research organisations and conferences, such as DiGRA 2003, have emerged; at the same time, the subject matter is increasingly taken more seriously by the general public, mass media and the academic community.

One area of especial interest is in the use of computer and video games, or their components, methods and features, in education. This is not a new concept: "learning software", "edutainment" and other games-oriented methods of providing education have been in existence for some time. However, the increasing use of "pure" computer and video games by a wider section of the population, and their attractiveness, complexity and playability have recently led to discussions and an increasing body of research into their use in formal and informal education. Various literature and books [1] make increasingly

strong cases for either the use of gaming technologies and techniques in school-based education, or the use of games themselves.

Partially in response to this movement, a number of research projects (some referenced below) have evaluated the use of PC-based games in the classroom; results have been positive. In this paper, we look at schools which have gone one step further, using these "pure" games in the classroom. In particular, two surveys are presented in which data pertaining to game usage in schools was collated. The results of these surveys are presented in terms of the main scenarios in which games are used, obstacles to their usage and, finally, emerging trends in their employment.

DEFINING GAMES

In this report and the associated surveys, we look only at those games that were originally designed as entertainment products. The surveys do not include learning-oriented, or "edutainment", software. In addition, we look only at those games that are produced for the PC or for video game consoles, i.e. the Xbox, GameCube and Playstation ranges.

THE 2002 BECTA SURVEY

A small and informal survey was commissioned by the British Education and Technology Agency (BECTA) and undertaken by one of the authors of this report in the spring of 2002 to uncover and investigate examples of how and where computer and video games were used in schools. The survey discovered the following:

1. The vast majority of computer games used in the classroom (or computer lab) were education-oriented games, as opposed to the "pure" computer and video games that we were looking for.
2. Relatively simple simulation games were found to be the most common type of pure game used. More instances of Sim City and RollerCoaster Tycoon were discovered than any other (pure) games.
3. Nearly all of the games were PC-based, with hardly any schools using console-based video games during formal lesson time. However, several schools possessed a limited number of Playstation consoles for recreational (as opposed to subject-based learning) activities, or for rewarding good behaviour.
4. Examples of the use of games in classrooms were most common in the US, mainland Europe and Australia. Examples in the UK tended to be of an experimental nature, or part of an academic research project.
5. Many teachers recognised the impact of games consoles on the lives of many of their pupils. However, there was significant reluctance to consider the use of such consoles in the classroom, due to their marketing as hosts of purely "fun" software, the lack of any non-games software, and concerns regarding the need to learn how to use and maintain another type of hardware.

The survey also uncovered a number of obstacles encountered by teachers who wished to use games in the classroom. These are discussed in more detail later in this paper.

UPDATE OF THE SURVEY

This informal survey was re-executed in the summer of 2003, as an independent survey by the authors of this paper. Examples of schools using computer and video games in the classroom were located by methods similar to those used in the BECTA 2002 survey:

- Following up contacts from previous games-related research.
- Internet searches, looking primarily for the names of likely classroom-use games on school web sites.
- Postings to games and education mailing lists.
- An examination of the archives of games and education mailing lists.

We were especially keen to obtain replies from teaching staff who had direct involvement in facilitating computer and video game use in the classroom as part of a formal, curriculum-based activity. Such respondents were invited to participate in more in-depth electronic discussions and questioning.

Our survey looked at instances of the use of computer and video games in UK schools. However, partially to add more context and comparative data, and partially because of a very poor number of UK-based examples, the survey was extended to take in other countries and geographical regions, especially the US and mainland Europe.

GAMES USED OUTWITH THE CURRICULUM

We discovered five main scenarios in which games are used in schools outwith of curriculum-lead, lesson-centric activity.

1: Games in schools as research projects

In a number of cases, we discovered that games had been used during a lesson for learning purposes, but as part of some academic research project investigating the effectiveness of such an approach. Three examples of such projects from the UK were:

1. The BECTA Computer Games in Education project [2]. This included the use and evaluation of 6 games from various genres in a number of schools.
2. The TEEM project [3]. Here, pairs of teachers were asked to evaluate games with pupils in specific age groups, and within their mainstream teaching if possible. The games were a mixture of pure entertainment titles and learning-through-fun oriented titles.
3. The Sim City Case Study [4]. Here, four schools used one simulation game (in which pupils developed a city and took on a simplified mayoral-role) in order to assist in the development of numerical skills.

All three studies, and others affiliated to similar research projects, gave mainly positive results. Generalised trends from such studies show that:

- Children were usually engaged by the games, and often played beyond their required time.
- Measuring exactly what they are learning is problematic.
- Teachers often spent more time learning about the game, and solving technical problems, than they initially allowed for, or found acceptable.

- Games not designed for the classroom, even when relevant and appropriate in terms of content, often had distracting or irrelevant content (which often could not be avoided). For example, the opening sequence of a particular strategy simulation game consisted of a 4 minute full motion video, which could not be disabled and therefore had to be played at the start of every session.
- Similarly, games often had many features and functions which were not required for use within the lesson-led session. As well as adding complexity to the interface, pupils would be tempted to use some of these functions, providing unplanned outcomes to the session.

However, it was disappointing to note that, despite recognition that the games provided valuable learning experiences, hardly any of the schools that took part in these research or evaluation projects continued to use the games after the projects ended. While there was evidence from some of the pupil feedback that playing of the games continued at home, and in many cases involved parents, it would appear that in most cases schools regarded this kind of research as more experimental, rather than piloting, in nature.

2: Games in school-oriented competitions

In a few cases, we discovered that computer and video games were used as primary equipment in competitions aimed at school children. For example, one high profile national competition [5] "introduces students to engineering with the popular Sim City software", and provides this free to participating schools. The pupils used the simulation game as a design tool, then used the design to create a scale model of their city.

3: Games used in computer clubs

A number of schools have computer clubs. In the UK these are more likely to be found in private schools, but it appears they are more common in continental Europe and the US. In the US, such clubs often offer the possibility to play games both *before* and after classtime (in the UK, the examples we located were all post-school day). For example, Bertie Backus Middle School [6] offers Sim City as an option as part of its "Science, Engineering, Communications, and Mathematics Enrichment Club", while Bishop Union High School provides evenings of computer game opportunities [7] in the school library.

However, in the majority of cases, the use of such games was largely unsupported or unsupervised, and not part of some cohesive learning or skill-enabling programme.

4: Games as a vehicle for literacy or critique

A few schools were identified which used the school children's interest in games as a vehicle for developing literacy skills (e.g. describing favourite games) or analytical skills (e.g. evaluating a particular game).

For example, students at Kenston High School [8] have written a substantial number of reviews of computer and video games for a web site aimed at high school computer game players, which was entered in a school-based competiton. Many other examples were uncovered of pupils creating web pages describing their favourite computer and video games, often in significant

detail; for example, there are many pupil "home pages" that contain information about the game "Age of Empires" (see, for example, [9]).

5: Games as a reward for good behaviour

In a few schools, games (mainly PC-based titles, and usually selected by the school) were made available as a reward for good behaviour during break times (though one teacher maintained that the real motivation was the restriction of access to games for bad behaviour).

Some schools are generally reluctant to let pupils bring in their own games for either their own use or for use on school equipment, possibly due to licensing issues, and lack of control over the use of the equipment as well as value judgements on the worth of such activity. The policies and procedures handbook of Blanchard Memorial School highlights some additional reasons [10]:

> "Electronic hand-held toys and games are prohibited on the school buses and on school property. These toys/games are banned due to issues of classroom disruption, potential for isolating behavior, and damage or theft liability. These toys include, but are not limited to, the following: Nintendo games, video games, Walkman (personal stereos), laser pointers, etc."

GAMES USED WITHIN LESSONS

Conventional uses of games

Of the examples that our survey discovered, most games belonged to the strategy and simulation genres of gaming. This is not surprising: simulations are an established method of demonstrating and modelling within a range of educational and working environments, while strategy games require the use of skills such as information interpretation, logic, discussion and evaluation.

RollerCoaster Tycoon was employed in the classroom in a number of cases. This appeared to be because:

- The subject of rollercoasters was appealing and stimulating to school children.
- The game could be used as part of a larger project, e.g. modelling how rollercoasters worked, or understanding physical concepts such as gravity and velocity.
- The game could be used across a number of subject domains, such as physics (motion and velocity), and business and economics (running a theme park).

For example, Farmington High School [11] used this game as one of a number of tools and resources in a physics-orientated lesson:

> "This activity will provide students with the opportunity to research the history of roller coasters and the physics behind the operation of roller coasters. After the students have a good understanding of roller coaster physics, the students will use Hasbro's computer software demo, RollerCoaster Tycoon, to design and test possible roller coasters. Finally, students will

> design a model roller coaster, and then actually build the model and test it for operation."

(Interestingly, in this and several other cases, the software is not mentioned on the school web site as being a game, but as "software", "a demo", "a simulator" or some other more study-oriented description.)

Correspondence from teachers indicated that there was much enthusiasm for the use of computer games in the classroom, and a number had attempted to use a variety of titles. For example, one teacher from Newcastle commented [Paul Smith, private communication]:

> "After examination of the BECTA and TEEM reports, I decided to experiment with City Traders in my class of 13 to 14 year olds, as they are a bright lot and, unless challenged, became easily bored. The students found the game itself relatively easy to play. However, they did have an uncanny knack of doing things that I suspect the game designers never thought possible; after the first session I realised that a far more rigorous lesson plan and game instruction was required than that I had originally provided!
>
> The other significant problem was with installation and use on the PCs in the laboratory. Despite being only 6 months old, and the game itself not requiring the lastest graphics card or large amounts of memory, in every session there was some technical or compatibility problem which led to one or more PCs not being useable [for this game]."

A number of schools, such as St. Volodymyr School [12], produced web-based guides to some of the games that they used; these are increasingly created by the pupils during or after they had experienced the particular title. It was also noticed that some schools that operated distributed or remote educational programmes, such as those based on islands or large geographic areas, often offered titles such as Sim City as part of a library of loanable software, available to pupils e.g. [13].

Another teacher commented on the interaction that arose between pupils as the result of using a strategy game [Gillian Reynolds, private communication]:

> "Though it wasn't part of any curriculum-based work, we had some time left towards the end of term in one of the blocks and the class were slightly ahead of schedule. We installed Black and White on four PCs, put the pupils into groups and gave them a relatively free rein. Never have I heard so much talking, arguing and discussion amongst them [11 year olds]! Pupils justified their choices of actions to others in their group; discussed strategy to a depth which would make an army commander proud; and came back after school to continue, often in groups. Pleasingly, the most vocal people in the class were the two pupils who were usually the quietest and most withdrawn; playing the game seems to have altered the social class dynamic at least temporarily. It is a pity that the testing-oriented timetable means that opportunities such as this will not arise for the rest of this year at least ☹"

Unconventional uses of games

A number of cases were uncovered where a game was used for subjects that are not obviously connected with the game.

For example, schools within the Russellville school district used RollerCoaster Tycoon [14] as part of musical appreciation classes. Here, pupils would research selected 20th century musical styles, then "create one portion of an amusement park based on their chosen musical style". For example, the souvenir shops would sell items associated with the chosen musical style, and all park employees must be associated with the style. In a case such as this, the game seems to be tangential or incidental to the key objective of the class.

OBSTACLES TO USING GAMES IN CLASSROOM

A number of obstacles to the use of games in the classroom were discovered in the 2002 survey. Many of these were reinforced by the 2003 survey. In the following two tables, we tabulate obstacles mentioned both frequently and occasionally.

Obstacle	**Notes**
The limited timespan of individual classes means that games are required where the student is "immediately learning". Time cannot be wasted on learning complex controls, playing through irrelevant content or watching introductory full motion video.	Mentioned heavily in both surveys.
Verification that the game is suitable for learning purposes, i.e. that the content is accurate and appropriate, is required, possibly through recognised independent branding.	Mentioned heavily in both surveys. Such verification also helps the teacher justify the purchase and use of the game to others in the school.
Support material for teachers needs to be provided. This could include descriptions of scenarios that can be enacted through the game, methods of evaluating the players'/students' performance, or cases and exercises for the pupils to work through.	The support material is viewed as important as the game itself, though it is unclear exactly what the teachers require.
School IT licensing agreements sometimes make it difficult to introduce specific new software onto school networks.	A problem mentioned by several UK teachers, hindered by institution or local education licensing agreements.
More contemporary games require either new and expensive PC hardware, or expensive (and unjustifiable) upgrades of existing classroom PC technology.	Mentioned heavily in both surveys. Teachers require games that are able to run on the school equipment.

Teachers have a lack of time to familiarise themselves with the educational components of the game.	Carefully written support material, as well as games with irrelevant content and functions removed, would reduce the time taken to become familiar with the title.

Frequently mentioned obstacles

Obstacle	**Notes**
"Save position" functions need to be included so that the student can stop at the end of class, and resume at the same place at the start of the next session, without loss of data or duplication of play.	Mentioned in both surveys. Viewed as essential for when lesson times are an hour or less.
Versions of games need to be tailored to the curriculum of the individual country.	With some games this could become a problematic development overhead.
Games are costly, and are therefore politically and fiscally difficult to justify.	A few teachers expressed frustration that the same kind of multi-machine licensing packages available for much ICT software are not available for games software.
Sometimes, having completed a game, school children still feel engaged in it. "Learning momentum" is lost because games are closed environments in which there are no options to continue or explore further, usually merely a "Play again?" option is provided.	"Futher exploration" literature should be included, containing details of related web sites to explore, information to find, set tasks to carry out, and novel ways, e.g. specific problem solving or situation analysis, in which the game can be used again.

Occasionally mentioned obstacles

Most of the obstactles mentioned in the previous two tables also surfaced in the TEEM research [teem].

TRENDS

It should be stressed that both surveys were small in scope and informal in nature and methodology. Therefore, we do not present our results as conclusive statements regarding the use of computer and video games in the classroom.

In addition, various factors that were not taken into account may affect our impressions of the "state of play" of games in the classroom. For example, the output of several games, e.g. pictures, designs, completed simulated models, is easier to display on school web sites than the output of other games which

also might have been used, giving an unbalanced impression of which games predominate in the classroom.

Despite these reservations, we did draw out some conclusions from the two surveys:

1. As both the 2002 and 2003 surveys, the vast majority of computer and video games that we came across were education-oriented games, as opposed to "pure" digital games. However, some progression was noted between the two surveys and, in 2003, we discovered an increasing number of schools allowing their pupils to create games and simulations using a variety of simple tools and software packages.
2. In most cases, "pure" digital games were not used for the most obvious purpose, e.g. using Sim City as an economic/budgetary simulation, but for other purposes, such as recreation e.g. a computer club, or as a reward for good behaviour.
3. Video console games were still considered to be of limited immediate use in the classroom; software was perceived as unsuitable and consoles of little use other than "pure" gaming. In addition, two teachers indicated that strategic and simulation games were found more on PCs than gaming consoles.
4. The most used games were still simulation games such as RollerCoaster Tycoon and Sim City. Several teachers expressed concern over the accuracy of content, and whether compromises between complexity and playability resulted in the players/school children receiving inaccurate and simplistic ideas of how particular scenarios realistically operate, e.g. budgeting for the development of a city.
5. Another reason why games such as RollerCoaster Tycoon were relatively common in the classroom is their relevance, or potential application, to a large number of subject areas (thus also making the software more cost effective). This also increases the chances of use of, or output from, such games being made publicly available.
6. Teachers were frustrated with the quantity of non-relevant content in games, such as full motion video, but understood the rationale for their inclusion, i.e. to provide a more rounded product for home-based players who did not have the same time constraints as teachers in classrooms. Several teachers would have liked to use specific games they had encountered, but an abundance of irrelevant and distracting content and functionality was off-putting.
7. Not surprisingly, there was an absence of the use of more controversial computer and video games in schools, such as titles with a significant or notorious amount of violence, e.g. the Grand Theft Auto series of games. However, several teachers and web sites indicated that school children were often very adept at installing such games onto PCs, often during lessons when very different activities were planned. While this does not lead to any useful learning experience, one teacher pointed out that, at least partially through this practice, some children in his school were now far more proficient than any of the staff in installing and upgrading complex software.
8. Games were usually introduced by the actions of an enthusiastic teacher who is familiar with a particular game, and can see the potential that the

game has to a particular class or subject. It is less common for games to be introduced as a defined school policy, and virtually unheard of for "pure" computer and video games to be introduced (except as part of a research project) at any regional or national level.

9. Several teachers mentioned the emergence of online games and expressed a great interest. Though not a new form of game playing, at the time of the 2003 survey online gaming forms such as MMORPH were attracting coverage in various media, especially relating to the capacity for large numbers of simultaneous players. Two teachers suggested the possibility of such technologies allowing inter-school games-oriented learning, such as classes from different schools playing as nations or tribes in a historical strategy simulation. However, using online methods gave rise to concerns about security, inappropriate people joining in, and access to unwanted or inappropriate Internet-based content.

CONCLUSION

The results of our survey suggest an ambivalence to the use of computer and video games in the classroom. On the positive side, it is encouraging to see that an increasing number of schools are using computer and video games in a variety of situations, many of which are imaginative, or support the learning process within a range of other tools and resources.

However, on the negative side, it is disappointing still to see a general lack of games being used for relevant subject-based learning. It is frustrating when, for example, schools provide games for recreation or as rewards for good behaviour (thus recognising that children like to play them), but fail to use them for learning-oriented purposes even where this potential is recognised.

This is all the more disappointing due to the steadily growing body of school-based research indicating the positive use of specific games in certain class-based lessons. Though we have mentioned some of the obstacles that were described to us, there is a need for more research (resulting in practical solutions) into why schools are missing out on opportunities to use such games as learning-supporting tools. Early indications suggest a lack of external recognition of the learning that takes place during game play, with content acquisition still leading the assessment agenda [15].

Continuing the survey

It is envisaged that, as part of the authors' ongoing research programmes, the survey will continue while it remains relevant, i.e. until games become mainstream in schools or are abandoned. An update, including example cases, will be presented at the DiGRA conference. Our next goal is to locate funding to formalise the project, providing:

- A more rigorous method of uncovering examples of the use of games in the classroom.
- A more structured methodology for extracting critical and usable information from discovered examples.
- A database of examples of the use of such games in the classroom.
- More detailed case studies of schools that use computer and video games as integral tools in learning scenarios.

- An investigation of game design and construction as a vehicle for learning.

Similar surveys in other countries

A variety of national differences exist at the technical, curriculum, social and pedagogical levels in school-based education. In the United Kingdom alone, there are significant differences in the curriculum content of schools in Scotland, Northern Ireland and in England and Wales. These differences need to be identified and factored into any international survey, or it may be appropriate for agencies in other countries to carry out their own localised survey. Either way, the proposed research would provide a common platform for conducting such evaluations and collating data.

The authors of this paper wish to hear of similar initiatives in other countries, with a view to exchanging results, findings and methodological procedures.

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REFERENCES

1. Gee, J.P. (2003) What video games have to teach us about learning and literacy. Palgrave Macmillan: New York.
2. BECTA Curriculum Software Initiative: Computer Games in Education Project available at: http://www.becta.org.uk/research/research.cfm?section=1&id=2826
3. McFarlane, A., Sparrowhawk, A. and Heald, Y. (2002) Report on the educational use of games. TEEM (Teachers Evaluating Educational Multimedia) available at http://www.teem.org.uk/resources/teem_gamesined_full.pdf
4. Sim City: Using a Simulation Game to aid understanding of Number. Available at: http://www.rbksch.org/maths/Teachers/schools/simcity/scindex.html
5. Future City details available at: http://www.successbeyond.org/fcc.htm
6. Description of school activities and clubs at Bertie Backus High School available at: http://www.k12.dc.us/schools/Backus/clubs1.html
7. Bishop Union High School available at: http://www.buhs.k12.ca.us/
8. Kenston Video Games project available at: http://www.kenston.k12.oh.us/khs/video_games/videogame.htm
9. Age of Empires II: Age of Kings student web site available at: http://vm.robcol.k12.tr/~jhogue/student_02_03/c1nl_web2/batu/kinikoglu_batu.html
10. School policies and procedures handbook of Blanchard Memorial School available at: http://www.boxboroughschool.org/Handbook/Policies%20Procedures.htm
11. Farmington High School Roller Coaster Mania web site available at: http://www.farmington.k12.mo.us/school/hs/departments/curr/rollercoaster/

12. St. Volodymyr School guide to building and maintaining a city in Sim City available at: http://www.scs.sk.ca/vol/Guides/sim_city.htm

13. SIDES (South Island Distance Education School) CD software library (science section) available at: http://www.sides.ca/html/CDList/Sc.htm

14. Foster, J. (2003) WebQuests and Simulation Gaming: The Perfect Interface available at: http://rsdweb.k12.ar.us/departments/tech/techint.htm

15. McFarlane, A..E. ed (2003) Assessment for the Digital Age, Assessment in Education vol 10(3)