



National
College of
Ireland

*The college for a
learning society*

The Learning Game in the Game of Learning:
A Theoretical and Practical Study of Computer Games as
Applied to Education

Zheng Wu

Ian McLeod



Working Paper NCIRL- 015-2003

The Learning Game in the Game of Learning:
A Theoretical and Practical Study of Computer Games as Applied
to Education

Zheng Wu, zheng_wu@hotmail.com
Ian McLeod, National College of Ireland

0. **Abstract**

The computer games are a well-established tens of billions euros industry and well-established research area. Relatively the educational computer games are underdeveloped especially for adults. This thesis addresses the reasons behind this phenomenon. It investigates the success factors of educational computer games, procedure and shortcuts of developing educational computer games. It predicts the trend of future educational computer games development. It also produces software for study.

Learning and education is not generally easy. Some teachers however deliver learning in such an artistic and enjoyable way that it is a kind of entertainment and resembles games playing that is a form or spell of play, fun, entertainment or amusements, often but unnecessarily played competitively according to sets of rules, goals and uncertainty and computer games refer to games that are played by using computers as tools.

On the other hand not all students are fortunate to meet teachers who have such skills in imparting learning and knowledge. If educational computer games learning could alleviate a learner's burden even a little, it would be a substantive contribution to educational learning. This is an interesting, attractive yet serious and practical research area.

1. **Aims of research**

The purpose of research is to answer the questions – “Can people [students?] really learn from games?” and “How can the learning from game be optimised?” in order to establish the reasons why computer games are under used in cognitive learning and evaluate the potential of computer games in cognitive learning.

It is envisaged that the findings of this research will be of particular interest to Ministries of Education, Education researchers, Curriculum designers, Educational strategists, Educational Software Research Institutes, Legislatures, Military Academies, Political, Military and Business Strategy Research Institutes, Computer games industry and people involved in fields of training, education and entertainment.

2. Literature Review

A literature review capturing the concepts of cognitive learning, computers, education, computer games, computer games for learning, optimisation of learning and the impact on learning from computer-aided strategies will be documented.

It is anticipated that the literature review will utilise the following authors' texts: Alessi and Trollip (2001); Chisholm (2001); Collis and Moonen (2001); Grabe and Grabe(1996); Inglis, Ling and Joosten (1999); Jenkins (2002); Klawe (1998); Laver (1997); Leyland (1996); Lockwood and Gooley (2001); McConnell (2000); McFarlane, Sparrowhawk and Heald (2002); Merrill, Hammons, Vincent, Reynolds, Christensen and Tolman (1996); Rinvolutri (1984); Rubin, P.I., Murray, O'Neil and Ashley (1997); Salmon (2002, 2000); Sedighian and Sedighian(2002); Sloman (2001) and Wright, Betteridge and Buckby (1983). Web references have been listed separately in the bibliography.

This literature review will be expanded as the research progresses.

An initial literature review has been initiated around key variables of the research objectives and research questions using the above texts. Several of the headings of this initial review are documented below.

Alessi and Trollip (2001, pp. 19-39) define cognitive learning as the process of knowing, that emphasize mind, memory, attitudes, motivation, thinking, reflection, and other presumed internal processes which can facilitate learning. They state that many educators treat games as educational tools only for children. It has only limited application for adults (business study).

Leyland (1996) reports that educational computer games had not been well received in the marketplace. The reasons are not complex and will be further commented on in the literature review of the thesis.

Simulation and microworlds are important parts of educational computer games (Alessi and Trollip, 2001, pp. 213-238; Merrill, Hammons, Vincent, Reynolds, Christensen and Tolman, 1996, pp. 87-106) showing that games mirror life to a certain degree. Life itself has goals, adventure, unpredictability, competition, contest, fun, amusement, joy, sadness, happiness, fluke, twists, success, failure etc that are the characteristics of games and it is quite natural to combine games and learning. Learning itself should be a game (Jenkins, 2002). This research will form part of the game.

From an evolutionary and biological point of view, primitive humans learned constructively by imitating, experiencing and discovering (Alessi and Trollip, 2001, p. 39). There are evolutionary marks in our genes.

Some great and illustrious people have been advocates of special games, playing, curiosity, acquiring knowledge and thinking (Laver, 1997, pp. 161-167). Laver (1997, pp. 161-167) finds that Chinese ex-leader Mao Zedong

likened his guerrilla warfare to Go, the ancient Chinese game of encirclement. And Mao was the master of both. Laver (1997) jokes that the author himself can't distinguish between games and the 'real' world.

Computer games techniques have been applied to such serious and important areas such as nuclear experiment, fighter jets combat simulation, space exploration projects simulation etc. They are very sophisticated and practical (Alessi and Trollip: 2001).

Wright, Betteridge and Buckby (1983) remark that adults are willing to play educational games. Comparing with educational computer games for children, adult educational computer games should be more sophisticated, more realistic, subtler and more profound (Jenkins: 2002).

If we can associate the games with the most up to date and if possible live and serious international events and concerns and with the immediate usefulness for our every day life and real-world applications, we should be happier (Alessi and Trollip: 2001). The surface complication, sophistication is important, but more important is how deeply, practically the games are able to stimulate, to wake up learners to think, to understand, to analyse and to implement in real world life (Alessi and Trollip: 2001).

Klawe (1998)'s experiment convinces that "Reflective Direct Concept Manipulation" (RDCM) challenge-driven learning version is better than "Direct Object Manipulation" (DOM) and "Direct Concept Manipulation" (DCM).

This is also a great and exciting opportunity of the fusing and encounter among arts, culture and science that might produce magical sparks (Chisholm: 2001).

The Relationship between Education and Games

The relationship between education and good games is not conflicting or contradictory. Instead they are complementary, mutual beneficial, mutual aiding and mutual cooperating, because education themes and purposes elevate the level and quality of the game's entertainment value. Good games render education as an art. That is a kind of sublimation (Jenkins: 2002; Chisholm: 2001).

Educational computer games are actually in great and urgent market demand for all ages, the general public simply don't know the possibility and potential (Jenkins: 2002).

With the fast pace of globalisation, information and knowledge explosion, hi-technology development, we are devoting more and more time of our life to education and learning by using hi-technology. Life long learning and education are becoming the fashion and trend (McConnell: 2000; Inglis, Ling and Joosten: 1999).

Sedighian and Sedighian (2002) point out that learners need to link learning with some pleasant memory to reinforce and enhance their learning (work hard and play hard!).

International VIPs are taking very important and serious actions. BBC News (2002) broadcasts that the British government encourages developing computer games to be educational especially for young people.

Chisholm (2001) reports that a "games-to-teach" project has been established by the alliance of education and research giant MIT and hi tech industry giant Microsoft.

News Release: SE1594/1999 (1999) states that Scottish Deputy Minister for Children and Education Peter peacock urges computer games developers to produce more and better educational computer games. The government was spending more than 100 million pounds to support the educational computer games related research and development in 1998 and 1999.

York University (2002) reports that the Canada federal government announced funds for research at York University in educational computer games.

The next step is how to produce educational computer games. Collis and Moonen (2001) describe the core of their opinion is 4 Es - environment, education effectiveness, ease of use and engagement.

User (including learners and teachers) centeredness is very important. Their information is vital for research. Information of their characteristics, background, preference, hardware, software availability, attitude, response, suggestion, feedback will be analysed and studies as early as possible. A prototype model for testing is suitable here. This is the engagement of the 4 Es (Alessi and Trollip: 2001; Collis and Moonen: 2001).

If possible, a chart of learner characteristics will be established. Problems will be detected. Their bandwidth, equipment and other conditions will be considered. The limits and boundary will be tested (Alessi and Trollip: 2001).

Rubin, P.I., Murray, O'Neil and Ashley (1997) address the issue of female learners. Their conclusions are that female oriented educational computer games are underdeveloped, the demands are great and the expectation is high.

Lockwood and Gooley (2001) demonstrate that the teachers' beliefs and interpretation of flexible learning is very important. How to convince them the need for change is the key success factor.

Klawe (1998) points out that the teacher involvement and student awareness and the connection with other activities are some of the success factors. Authoring tools could help teacher control their programs to some degree.

The bridge and close cooperation between teaching experts and technology experts are vital, because their spheres of knowledge are different. Technology

experts can provide skeleton, bricks for building and possibility. Teaching experts can provide fresh contents, general methods and direction. Their combination is the final products of the dream team (Alessi and Trollip: 2002).

McFarlane, Sparrowhawk and Heald (2002) remark the importance of sound effects, corresponding movement and singing of songs, learners' respond from their visual perception, hearing, smelling, touching and feeling. Also their imagination in art, design, music, dancing, imaginative role-playing and storytelling should be utilised.

Laver (1997) describes how to use intrinsic and extrinsic motivations such as money, booze or music etc to create and control game atmosphere, environment and direction. He also states that suitable environment construction is very important and relevant to the games. He emphasised music usage – for example, different music volume can change the players' behaviour.

Leyland (1996) proposes constructing environment that encourages imaginative freedom and reflective reasoning, because the procedure of imagination is obviously easy and straightforward. People are willing to immerse themselves in the gameplay that stimulates imagination and learning.

Salmon (2000) summarise that since 1980s, there is no major change for computer monitors and keyboards, but the breakthrough is approaching. Synchronous voice recognition, mobile and portable connectivity will be the new hi tech stars, though they are inaccurate and primitive at the moment. Preparation should be made for the new era.

Merrill, Hammons, Vincent, Reynolds, Christensen and Tolman (1996) classify individual motivations as challenge, curiosity, control, fantasy and interpersonal motivations as cooperation, competition and recognition. They are all intrinsic motivations and more efficient and nobler than extrinsic motivations.

Alessi and Trollip (2001) argue that in order to protect weaker game players, most computer games avoid competition among individuals, instead team games are recommended. This is questionable. We may protect learners from individual competition inside schools, but we can't protect them from keen, even fierce competition in the big real society. Overprotection is harmful actually.

If we can let them learn how to face failures, how to adjust their psychological changes, how to adapt to this complicated, not always peaceful and friendly real society in an early and less harmful way by playing educational computer games, it will be more beneficial for them. The games should be delivered in such a way that learners know that the most important thing is participation, trying their best and challenging themselves. They can learn more from their own and each other's failures and helping each other than mere successes. But the real implementation is not easy. It is a kind of art.

But at the same time, games are unnecessary involving competition. Cooperation is as important as competition. And competition is not equal to challenge. Cooperation could be challenge (Wright, Betteridge and Buckby: 1983). The eclectic way is to integrate losing, winning, helping, cooperating and collaborating together.

Give learners maximal control over their courses and destinations as long as it is beneficial. They may control their program's pace and pacing. They know they are the real masters of their program. User control also includes exiting, reviewing, bookmarking (passive and active), control of hot text appearance, page background colour or pattern and so on (Alessi and Trollip: 2001).

The interactivity between learners and learners, learners and teachers, learners and computers is highly encouraged, especially to create environment for fellow learners to help and teach each other for the purpose of achieving their common goals. I will learn a lot from them too. For this instance, everybody is a winner, beneficiary and benefactor (Alessi and Trollip: 2001).

Adaptive environment and adaptive and admissible probability measures testing are useful for educational computer games. Learners' answers and responses may be scaled and analysed rather than simple right and wrong (Alessi and Trollip: 2001).

McConnell (2000) believes that learners assessing their own and others' learning through collaboration and cooperation will encourage democratisation, fairness, participation and skills development.

Rinvolutri (1984) argues that students should see the wrong responses, so give them a chance to analyse the reasons and to be more responsible. Teachers also have the benefits of having more free time to find out what the students actually know, so the courses could be more intensive.

Allowing learners seeing their own and other learners' wrong responses may give them more opportunity to reflect and analyse their own and each other's mistakes, therefore they are more likely to help themselves and each other. Then the maximal interaction is more achievable.

Salmon (2002) also describes two different views of learners' reflection. One believes that it is independent activity that needn't collaboration. The other thinks it is collaborative activity that needs cooperation. Using both of them is the practical approach. The most important is to give learners any chance if possible to allow them to reflect – before the game, during the game and after the game.

From reflection, they know what relevant knowledge they already have before the game, what knowledge they have used, acquired and constructed during the game and what knowledge they have organised and consolidated aftermath (Alessi and Trollip: 2001).

Grabe and Grabe (1998) points out that learning is not mere reception. There is no absolute objective 'truth' for learning. Learning is through personal discovering, constructing, assembling, reflecting, producing, collaborating and cooperating of real world. Educational computer games are one of the right vehicles for learning according this theory.

Provide learners with any possible combinations of choices to cater for individual needs whenever and wherever possible, so the program could be highly individualised. The options and choices are to continue or quit, the different pace, style, combinations, special structure, taste, to play as group, teams, pairs or alone etc (Alessi and Trollip: 2001).

Klawe (1998) proposes multiple reward systems due to different learners' unique motivation orientation during different time and different learning stages.

For example, Store, accumulate and compare the scores of games results historically and currently, so individual knows their standing in their classes and their own progress to arouse their motivation. Allow fellow classmates to compete and encourage each other and to excel.

Endeavour to find the suitable games for our target learners. Technology is not always suitable, useful or beneficial. Sometimes they even could be counter-productive. Caution is wise here (Alessi and Trollip: 2001).

Simulations should be suitable and in harmony with educational and gaming purposes. For example, the French lessons should have French taste, style, music etc. The same applies to the other languages'. If feasible, learners should have the option of creating their own simulations. So they may use their creativity, originality and imagination. (Alessi and Trollip: 2001).

Sloman (2001) describe 3 Venues for learning – Campfires, watering-hole and cave. Campfires refer to the traditional learning mode. Cave refers to the reflection mode. Watering-hole refers to transitional and informal culture and society mode. The watering-hole venue emphasises the importance of culture and society awareness. The educational computer games are very compatible and suitable for the watering-hole learning venue, because it is transitional and informal.

Open-ended environment is full of fun and adventure, because it increases uncertainty, arouses learners' curiosity and helps learners to transfer and apply their new knowledge (Alessi and Trollip: 2001).

Hyperlinks have the balancing problem of readability, convenience and distraction. The trend is to experiment with different density, hidden hyperlinks, audio-hyperlinks and user control of hyperlinks appearance. The answer might be compromise (Alessi and Trollip: 2001).

One shortcoming of educational computer games is their lack of orientation and sense of place for the users. To counter this problem, the methods of

semantic cueing, table of contents, maps, timelines, searching bookmarks, metaphors will be used (Alessi and Trollip: 2001).

Transparency and visibility will be emphasised. Structure of information should be as transparent and visible to learners as possible. This could ease learners' anxiety and give them a sense of place and general ideas about the program and its underlying principles (Alessi and Trollip: 2001).

3. Methodology

The method used is the classical 'positivistic' design where data will be gathered and statistics used to test hypotheses.

My ideal game is predictive, real important events and affairs oriented, verifiable, evolving, dramatic, full blown, analytical and knowledge driven.

The most important feature is predictive. The reason is that predictive ability is one of the most significant for mankind. We live for today and tomorrow which can satiate our innate addiction for curiosity, though yesterday can teach us lessons, but the purpose by biological sense is still for the future. Using all achievable knowledge to identify problems, find out reasons and give answers and solutions to predict the future which is more attractive and appealing is vital for our survival, for the past, now and future.

Taking real international hotspot events and affairs as prediction targets might make games more interesting, relevant and challenging for adult players and learners.

Some players and learners complain that the rules, scores, referees and umpires are not fair. Verifiability might solve this problem, because scores will be given according to reality and the will of God.

The evolution of these games could provide context for the full development of the preface, expansion, climax and end. Because it is constantly refreshed and updated, it is more relevant, amusing and multifarious.

Dramatic effects are applied to nearly all aspects of art. Something unpredictable, uncertain and adventurous is generally more fascinating. The added flavour of my games is for players to experience the fancied drama slightly ahead of the real world. The real world is usually whimsical. So the real drama actually is the real world.

A full blown and complete growth of this kind of games caters for human nature. Most games on the market are nostalgic, fanciful and irrelevant. Human beings have the desires for nostalgia, fantasy etc., but this is not complete. The penchant for prediction is even stronger. The combination of prediction, nostalgia, fantasy and reality is relatively complete.

Providing enough chance for players to analyse and calculate current important relevant affairs might promote adults' enthusiasm for playing educational games.

How to optimise the two advantages of educational games – fantasy and simulation which can not or can not easily be produced without the aid of computer technology – is a question to answer.

4. Data Analysis

Data will be collected using all the safeguards exercised by researchers. Data will be collected by survey instrument, interview and multiple case studies.

It is intended to profile collected data and to empirically test the hypotheses with the data collected. A number of case studies will then be conducted to confirm the findings.

5. Conclusions

Conclusions will be drawn from the thesis' findings. Implications for policy and existing theory will be discussed. The project will conclude with recommendations and the limitations of the project will be identified. It will be demonstrated that the research has addressed the initial research questions. The entire project will be conducted in a manner that will maintain the highest safeguards towards validity and reliability.

Bibliography

- Alessi S.M. and Trollip S.R. (2001) *Multimedia for learning*, 3rd edition, Massachusetts: Allyn & Bacon, pp. 19-31, pp. 35-39, pp. 213-238, p. 270, p. 279, pp. 270-298, p. 381, pp. 485-486
- Collis B. and Moonen J. (2001) *Flexible learning in a digital world*, London: Kogan Page Limited, pp. 52-58
- Grabe M. and Grabe C. (1996) *Integrating technology for meaningful learning*, London: Houghton Mifflin Company, pp. 47-49, p. 60, pp. 65-66
- Inglis A., Ling P. and Joosten V. (1999) *Delivering digitally*, London: Kogan Page Limited, p. 8
- Laver M. (1991) *Playing politics*, Oxford: Oxford University Press, pp. 2-10, pp. 161-167
- Lockwood F. and Gooley A. (2001) *Innovation in open & distance learning*, London: Kogan Page Limited, pp. 31-36
- McConnell D. (2000) *Implementing computer supported cooperative learning*, 2nd edition, London: Kogan Page Limited, pp. 128-129, pp. 187-236

- Merrill Paul F., Hammons K., Vincent B.R., Reynolds P.L., Christensen L. and Tolman M.N. (1996) *Computers in education*, 3rd edition, Mass.: Allyn & Bacon, pp. 87-106, pp. 99-101
- Rinvolutri M. (1984) *Grammar games*, Cambridge: Cambridge University Press, p. 3
- Salmon G. (2000) *e-moderating*, London: Kogan Page Limited, p. 94
- Salmon G. (2002) *etivities*, London: Kogan Page Limited, pp. 92-93
- Sloman M. (2001) *The e-learning revolution*, London: CIPD, p. 116
- Wright A., Betteridge D. and Buckby M. (1983) *Games for language learning*, new edition, Cambridge: Cambridge University Press, p. 2, pp. 4-7

Web References:

- Chisholm A. (2001) *New models for teaching and learning*, Cambridge, MA: MIT Comparative Media Studies, Phone: 617-253-6447, email: alex@mit.edu, Website accessed on 24-10-2002
- Jenkins H. (2001) *Digital Renaissance*, Comparative Media Studies, MIT, Cambridge MA, Website accessed on 24-10-2002
- Klawe M. M. (1998) *When does the use of computer games and other interactive multimedia software help students learn Mathematics?* Department of Computer Science, The University of British Columbia, Vancouver, Canada, V6T 1Z4, email: vpsas@unixg.ubc.ca, Website accessed on 24-10-2002
- Leyland B. (1996) *How can computer games offer deep learning and still be fun?* Multimedia Development Unit, School of Arts, University of Ballarat, PO Box 663 Ballarat VIC 3353, Australia: B Leyland, email: bleyland@fs3.ballarat.edu.au, Website accessed on 24-10-2002
- McFarlane A., SparrowHawk A. and Heald Y. (2002) *An exploration by TEEM of the contribution which games can make to the education process*, TEEM Ltd, Shelford Studio, 46 Whittlesford Road, little Shelford, Cambridge, CB2 5EW, Website accessed on 24-10-2002, pp. 14-15
- Rubin A., P.I., Murray M., O'Neil K., and Ashley J. (1997) *What kind of educational computer games would girls like?* 2067 Massachusetts Avenue, Cambridge, MA 12140: TERC, Website accessed on 24-10-2002
- Sedighian K. and Sedighian A (2002) *Can educational computer games help educators learn about the psychology of learning mathematics in children?* Vancouver: Department of Computer Science, The University of British Columbia, Vancouver, B.C., V6T 1Z4, Canada, email: {kamran, andishe}@cs.ubc.ca, Website accessed on 24-10-2002
- York University, News release (2002) *Federal government funds York research on virtual reality, computer vision and educational computer games*, York University, 4700 Keele street, Toronto, Ontario, Canada, M3J 1P3, email: sbigelbow@yorku.ca, Website accessed on 24-10-2002