**SAGSET**

**Portsmouth**

**13th – 15th July 2005**

E W Simpson
University of Abertay Dundee
Bell Street
Dundee
DD1 1HG

e.simpson@abertay.ac.uk

O I Ogwuda
University of Abertay Dundee
Bell Street
Dundee
DD1 1HG

o.ogwuda@abertay.ac.uk

Title:

Water for Walami – a strategy game.

Abstract:

Educationalists may still develop practical and high quality learning resources that are not digital. The authors, having explored the potential difficulties in designing electronic based educational games, were determined to find a more practical and affordable educational game given their limited funds and other resources, yet still provide an innovative, flexible and high quality educational resource. The result is a game called Water for Walami.

The use of simulations in the subject areas of construction and civil engineering has proven success in the designers' experience with results published through an Accelerating Change in the Built Environment Education (ACBEE) case study for civil engineering students (Ogwuda & Simpson, 2004), and a Centre for Education in the Built Environment case study for construction students (Simpson & Ogwuda, 2004). Given the successes in simulations it was decided to go one stage further and develop a fully integrated and challenging simulation game that could be adapted to a wider target group of participants from secondary school level to postgraduate level. This was the challenge that the designers set themselves.

The designers of Water for Walami, are convinced that there is a niche market in educational resources for games such as Water for Walami, whereby the inventiveness of educationalists will continue to lead to high quality resources for learners in a breadth of media. The main drivers for a successful outcome are determination to succeed and a clear vision for the future with respect to a concept.

## Introduction

With the current variety of modes and media to deliver educational material, learners (which are increasingly diverse in their learning experiences prior to tertiary education) are expecting increasingly sophisticated and flexible learning resources. Different pedagogical methods activate a range of different cognitive processes (Clark, 1994). Water for Walami is an educational resource that has been designed through informed knowledge and understanding of theories of learning with the result that it can be expected to be effective in achieving the expected educational objectives for the participants (Trowler and Cooper, 2002).

At present, students and professionals studying at undergraduate and postgraduate level can expect learning resources of the highest quality from subject specialist television channels such as Discovery on Sky, specialist production companies such as the Television Education Network, the Chartered Surveyors' Channel (for example: Simpson, 1997), electronic learning games that are free/relatively cheap through on-line learning from various sources such as the BBC website. If a learning package looks less than professional, learners are unlikely to trust that resource (Race and Brown, 1998), however, the ability to produce high quality learning resources is not purely limited to those who have considerable funds to produce fully edited and produced material. Educationalists may still develop practical and high quality learning resources that are not digital. The authors, having explored the potential difficulties in designing electronic based educational games, were determined to find a more practical and affordable educational game given their limited funds and other resources, yet still provide an innovative, flexible and high quality educational resource. The result is a game called Water for Walami.

Part of the rationale for developing Water for Walami was to improve the learning experience, through specific educational versions, for undergraduate and postgraduate students. However, it was also planned that a secondary school version be designed with a view to informing prospective students of issues in particular subject areas and how strategic decisions and policy planning are critical for ensuring better management of scarce natural resources such as clean water.

The use of simulations in the subject areas of construction and civil engineering has proven success in the designers' experience with results published through an Accelerating Change in the Built Environment Education (ACBEE) case study for civil engineering students (Ogwuda & Simpson, 2004), and a Centre for Education in the Built Environment case study for construction students (Simpson & Ogwuda, 2004). Given the successes in simulations it was decided to go one stage further and develop a fully integrated and challenging simulation game that could be adapted to a wider target group of participants from secondary school level to postgraduate level. This was the challenge that the designers set themselves. Since starting the design for this game, the potential has been realised and even before the set of versions for Water for Walami have been completed for clean water, research expertise has been brought into discussions for other versions dealing with wastewater.

## Pre-requisites for successful learning.

There are four critical factors that underpin successful learning, regardless of the age of learners and the disciplines (Race and Brown, 1998):

- Wanting to learn, and/or needing to learn (motivation);
- Learning by doing (experiential learning, practice);

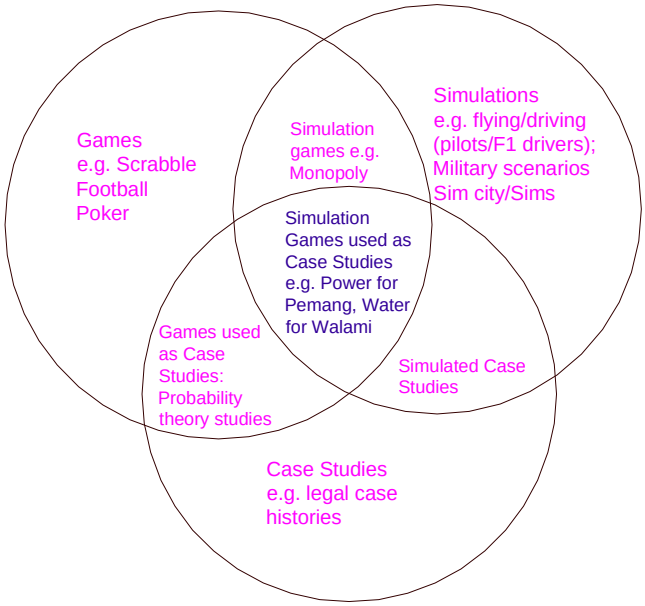
- Feedback (finding out how the learning is going): and
- Digesting (making sense of what has been learned – understanding).

If the above model is accepted then the effectiveness of the resource based learning within the game of Water for Walami depends upon embedding these factors within the game.

**What sort of education tool is Water for Walami?**

A game is, "any contest (play) among adversaries (players) operating under constraints (rules) for an objective (winning, victory or pay-off") (Abt, 1968). Ellington and Earl (1998) have deduced that to qualify as a game, an exercise must have two basic characteristics, namely, overt competition and rules (arbitrary constraints within which the players have to operate). A simulation, whilst intended to represent reality in a manageable context, also has particular characteristics. To qualify as a 'simulation' it has been ascertained by Ellington and Earl (1998) that it must represent a real situation and must be on going. A case study has been defined as, "an in-depth examination of a real-life or simulated situation carried out in order to illustrate special and/or general characteristics" (Percival and Ellington, 1980). In reality, the distinction may be somewhat harder to ascertain, therefore Ellington and Earl devised a model that demonstrates the overlapping sets of games, simulations and case studies as shown in Figure 1.

**Figure 1: The overlapping sets of games, simulations and case studies Adapted from Ellington and Earl (1998).**



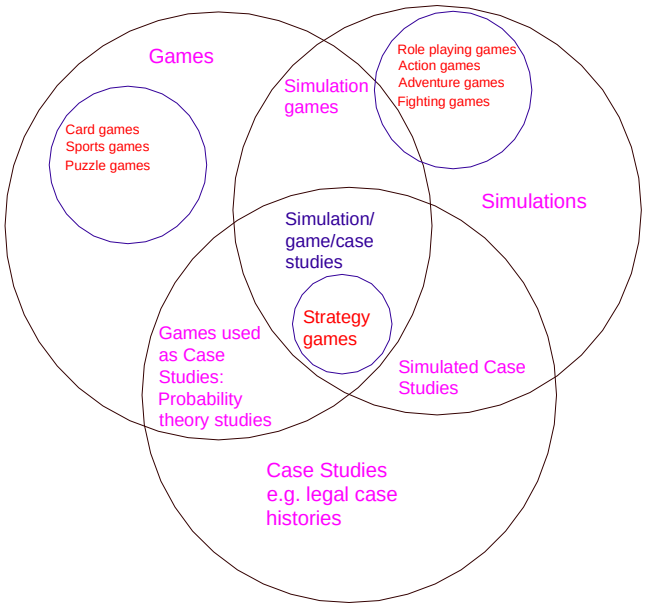

Whilst Ellington and Earl have identified 7 categories of games, Prensky (2001) identifies 8 categories:

- Action games
- Adventure games
- Fighting games
- Puzzle games
- Role-playing games
- Simulation games

- Sports games
- Strategy games

The distinction between these suggested methods of categorising 'games' is that Prensky has specifically categorised on the basis of a computer-based medium. Whilst the model of Prensky readily fits computer games it is less flexible when trying to categorise all types of game. It is possible, when looking at both models, to see that Prensky's categories either match those of Ellington and Earl, or are a subset within that model, as shown in Figure 2.

**Figure 2: Game sets**




The use of games for student centred learning was observed (1998) as having commenced with the 'humanistic' school of psychology in the 1960's (Percival, et al, 1993). In addition, with the increasing importance placed on gaining transferable knowledge and skills within tertiary education, games have proven to be an ideal vehicle (Ellington, 1995). A game can provide a Student-centred Learning (S-cL) approach to learning that helps to reflect the interests of as many stakeholders as possible (SLICE, 2002):

- Helps the students to learn
- Provides an effective and interesting challenge to the developer
- The department responsible can enhance the experience of its students

A 'deep learning' experience is expected from participating in this game as it is oriented towards making the game relevant to subject areas and skills of the participants, providing inherent interest and a sense of ownership of the tasks and outcomes. In order to ensure a deep learning experience the observations of McAlpine (2004) were followed to facilitate deep learning within the structure of the game and facilitator's pack:

- Provide clear and explicit explanations
- Demonstrate the potential relevance of the learning
- Offer participants an element of choice
- Structure a manageable workload for the available time

**Game Development.**
It has been suggested that it is possible to design a game in 90 minutes (Brown and Race (1996) – or even 10 minutes following an on-line course (Thiagi, 2004). The purpose and design of Water for Walami as a game came out of a 2-day workshop, but it has taken over 18 months to get from design concept to working reality, and even then the undergraduate and postgraduate versions are still being more fully developed at this time. One thing the designers learned during the development of this game is that whilst there is a lot of enthusiasm for the final product it takes considerable effort to get others involved prior to the final stages. In other words, the designers have to have a shared vision and sufficient resources in order to design the complete game and the skills to bring in others where and when needed. Designing Water for Walami has taken considerable perseverance and determination on the part of the designers, but has been worth every bit of effort.

Games are a highly versatile and flexible medium that can cover a wide range of educational aims (Ellington and Earl, 1998) and can be used to achieve learning at all levels of the cognitive and affective domains. Water for Walami is designed such that, in particular, the undergraduate and postgraduate versions engage participants in a learning experience involving high-level cognitive objectives covering analysis, synthesis, evaluation and problem-solving in addition to a variety of affective (attitudinal) objectives (Wentworth and Lewis, 1973) through the environmental related issues of the game. Water for Walami is designed as a compliment to core skills teaching, but requires participants to make use of analytical, problem solving, decision-making, communication, presentation and interpersonal skills, reinforcing what is covered elsewhere, making the learning relevant to a context that brings all these skills together.

The use of a simulated situation was decided upon as this enabled the game to be designed with all the features for learning that were considered desirable, but necessitated reducing the complexity of reality to manageable proportions for each of the target groups of participants. It is intended that upon successful completion of the game participants will have achieved positive transfer of learning in that they will have the ability to apply skills acquired in the context of the game in other situations (Twelker, 1971). Further, Entwhistle (1996) has observed that deep learning can be achieved through contextual learning. From what is known about simulations, they provide an educational tool that capitalises on three areas that are critical to the learning process (Stretch, 2000, p34):

- Simulations are motivating
- Simulations are social
- Simulations are experiential

Whilst Water for Walami is more than a simulation, it is worthwhile noting the advantages gained by incorporating this aspect into the game design. It was observed by Stretch (2000, p34) that motivation can be impeded with poor design and that motivation of the learner is dependent upon the complexity of the simulation. Further, a simulation that is too complicated may make the learner frustrated and unable to move forward, an overly simple simulation does not provide a challenge; therefore an awareness of the learner in designing the simulation is essential. The deduction that Stretch arrived at, which was followed in designing Water for Walami was, “the design must mirror reality only so far as the learner has the capacity to handle it”.

The bonus of getting participants to work together is the advantage of social interaction (Gordon, 1998). Interdependency of the individual participants is fostered through very careful design to develop purposeful interactions in and between groups, resulting in

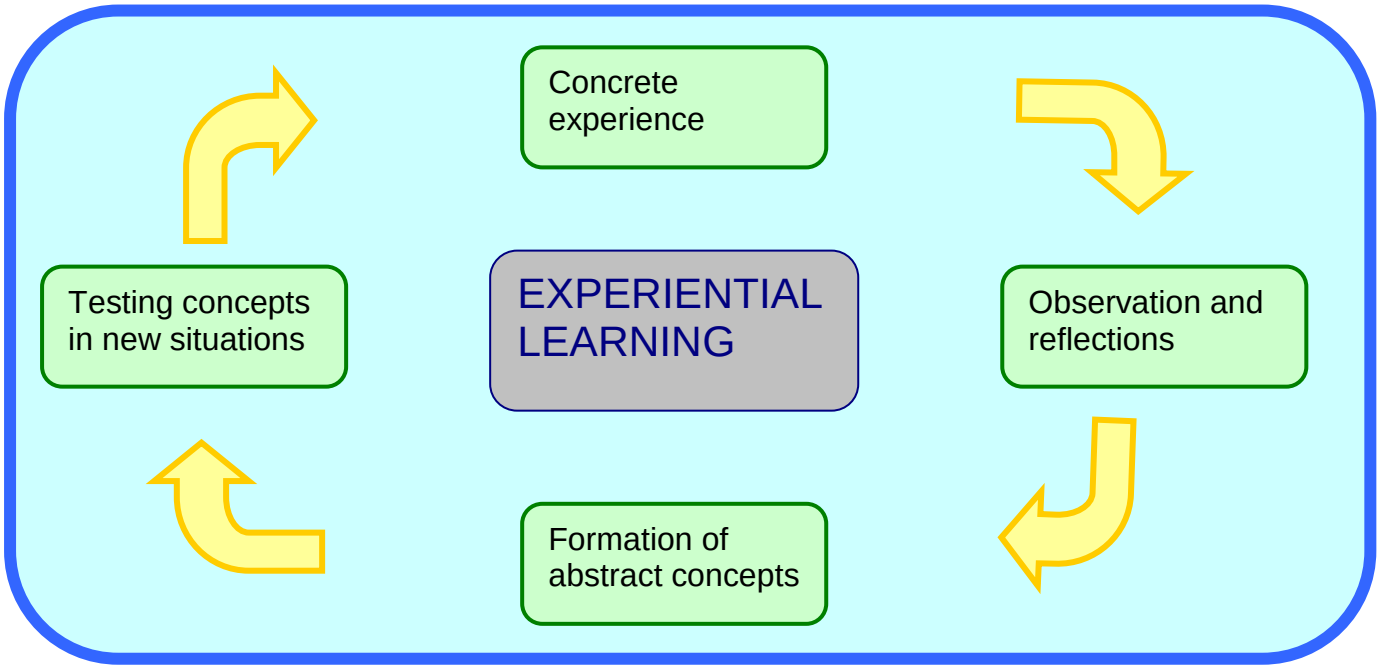
developing leadership, communication and decision making skills. An additional benefit of the social aspect of simulations is the reflective dialogue that can take place at the various stages of Water for Walami – allowing time for group reflection and strategy sharing throughout the process. The final presentation provides the opportunity for the main group(s) to present how they have solved the particular problem and the strategy used. Shared learning is known to help with enabling a wider understanding that aids learners in applying knowledge to particular situations (Connor, 1996). Through reflective dialogue, learners are able to reflect upon experience, thinking, and strategies whilst helping others to learn from their experiences.

Water for Walami also provides the opportunity for experiential learning in recognition of the four-stage cycle of Lewin (1951) where by the learning of the participants is constantly tested and incorporated to develop a deeper understanding of the concepts. The cycle of experiential learning is shown in Figure 3. Water for Walami helps the participants to develop their initiative and problem solving skills and to be creative in finding solutions to problems. As part of the design, to increase motivation, there is a deliberate element of competition in order to get participants to commit themselves to the exercise. The game also covers a wide range of subject interests, making this a game of multi-disciplinary interest, requiring participants to formulate value judgements for example, weighing economic benefits against social costs. The multi-disciplinary approach also has the advantage that people with different strengths in the various subject areas have to work together effectively in order to achieve a common end.

In order to ensure that the game was appropriate to the educational situation in order to achieve the optimum results the design team have worked on three versions to match each of the target populations, with each being pitched at the ‘appropriate’ level. The following are a further selection of reasons supporting the rationale for a non-digital based format for Water for Walami (although the use of standard desktop facilities can be incorporated by the facilitators using spreadsheets on laptop computers):

- Games give enjoyment and pleasure; they are fun.
- Not prohibitively expensive to design and develop.
- We had the skills to undertake the design and development; an earlier exploration into computer game design indicated that considerable expertise in programming and large teams were needed, in addition to prohibitively long development times.
- They can address, systematically, requirements for successful learning (motivation, practical experience, feedback and understanding).
- A game can involve the requirement to be creative at solving problems.
- A game can enhance various life-skills within a controlled context.
- Learning from mistakes can be done without fear; those used to games will take greater risks and be creative in problem solving when they are detached from reality in a game environment.

**Figure 3 Experiential learning**
**Stretch (2000).**




An expectation for participants is that Water for Walami changes behaviour in that it moves participants away from surface learning traits for memorisation to that of understanding by helping them to apply theory to practice, knowledge application within a context and analysis and synthesis of data to achieve a 'deeper' learning experience given that the game:

- Enables the learner to contextualise knowledge in order to apply what is known
- Fosters invention for applying knowledge, and creating solutions
- Enables the learner to predict implications of applying the knowledge

**Specific Educational Aims of Water for Walami: Secondary Schools Version (SSV):**

- To make the participants aware of the nature and scope of Natural Resource Management (NRM), and more specifically water.
- To provide participants with in-depth knowledge and experience of at least one specific aspect of NRM (water) through a detailed simulation game/case study that can match a range of criteria.
- To provide a stimulating and challenging educational experience that is both informative and enjoyable.
- To cover as far as possible strategic core skills (**IT; teamwork; communication; problem solving; numeracy**).

**The game may be used as an educational tool as:**

- A case study on the supply of fresh water and management of water supply, and for technological planning in science and engineering.
- A case study in economic analysis and planning with students of economics or accounting.
- A mind-broadening exercise with geography, general studies, environmental, modern studies or science students.
- A means to develop communication studies.

**Designing Water for Walami**

The game was designed, following the 3-stage model of Ellington and Earl (1998, pp 47-62):

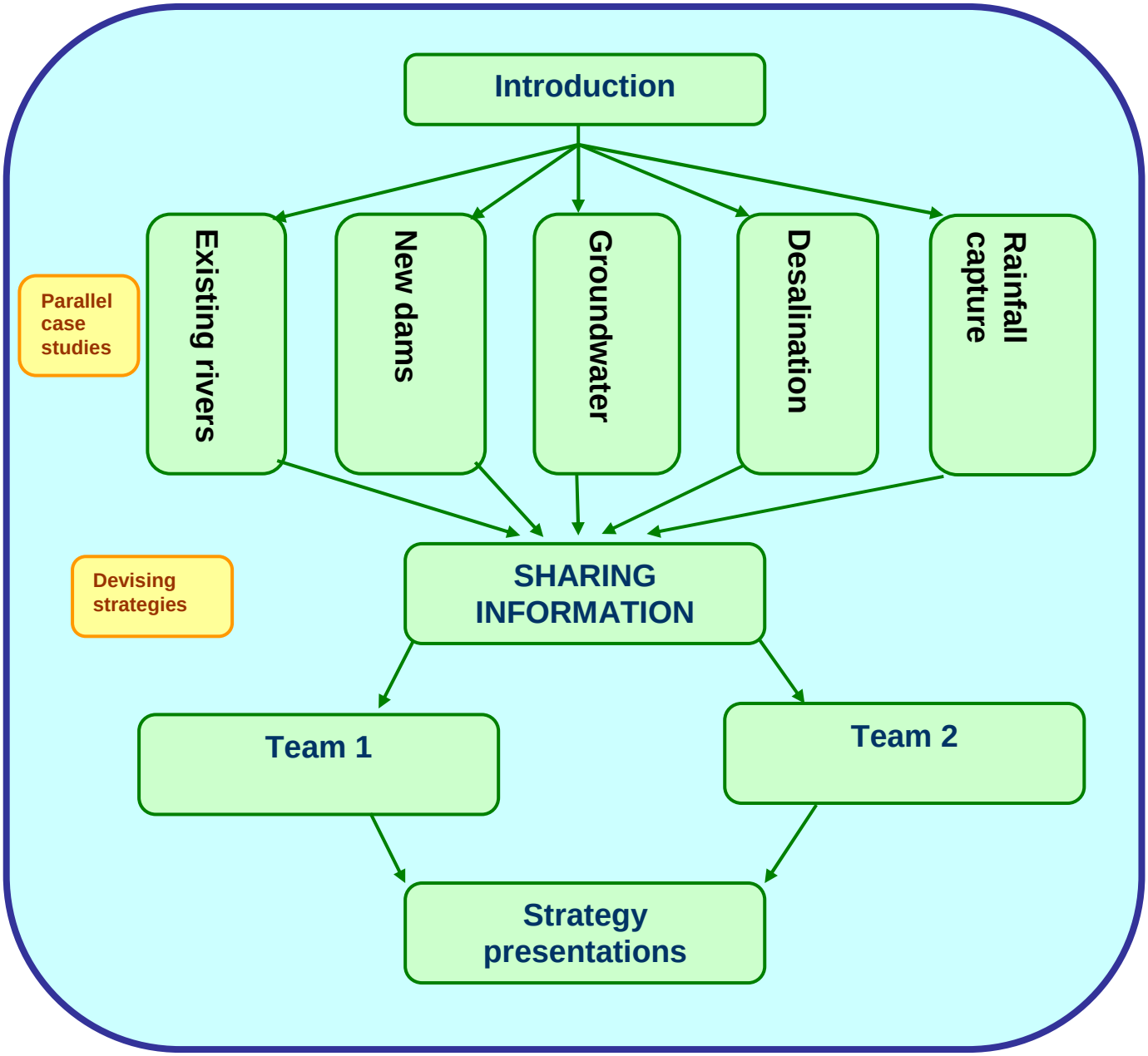
Stage 1: establishing the basic design criteria
- Target population(s)
- Design objectives

Stage 2: formulating the basic idea for the game
- Choosing the content/writing content
- Choosing the format
- Deciding the overall structure of the game

Stage 3: converting the basic idea into a viable educational package
- Deciding on the overall form of the package
- Producing a prototype package
- Field testing and revising the package

The game-play format (shown in Figure 4) may be described as a multi-player synchronous (real-time) game as the participants are playing with and against each other at the same time. This adds to the competition between groups and teams by placing themselves under a ‘sense of urgency’ to finish first both in time and position, enhancing the motivational element of the game.

**Figure 4 Game Structure of Water for Walami**




## Conclusions

The designers of Water for Walami, the authors, are convinced that there is a niche market in educational resources for games such as Water for Walami, whereby the inventiveness of educationalists will continue to lead to high quality resources for learners in a breadth of media. The main drivers for a successful outcome are determination to succeed and a clear vision for the future with respect to a concept.

**References**


Abt, C. C. (1968) Games for learning. In Boocock, S.S. and Schild, E.O. (eds.) *Simulation Games in Learning*; Sage publications, Beverley Hills, California.

Brown, S. and Race, P. (1996) Design a game in 90 minutes. *The Simulation and Gaming Yearbook Volume 4*; Kogan Page, London.

Clark, R. (1994) Media will never influence learning. *Educational Technology Research and Development* 42 (2): pp 21-29

Connor, M. (1996) Learning: The Critical Technology www.wavetech.com/whtpaper/abttmwp.html in Stretch, D.C. (2000) *Simulation and Gaming Research Yearbook*; Vol 8 (2): pp 33-46

Ellington, H. (1995) Educational innovation – where are we now? A critical review of recent developments. *Innovation & Learning in Education*; Vol 1 Number 1.

Ellington, H. and Earl, S. (1998) *Using Games, Simulations and Interactive Case Studies*; SEDA Paper 101; SEDA (Staff and Educational Development Association.

Entwhistle, N. (1996) Supporting effective learning: a research perspective. In *Quality in Higher Education*; Scottish Higher Education Funding Council

Gordon, R. (1998) Balancing Real-world Problems with Real-world Results, Phi Delta Kappan; 79 (5): pp 390-393

Lewin, K. (1951) Field Theory in Social Sciences; Harper & Row, New York.

McAlpine, L. (2004) Designing learning as well as teaching: a research-based model for instruction that emphasises learner practice. *Active Learning in Higher Education*. Vol 5 (2): pp 119-134

Ogwuda, O. and Simpson, E. (2004) Undergraduate Construction Skills Application. Accelerating Change in the Built Environment (ACBEE); on-line case study: http://www.cebe.ltsn.ac.uk/learning/acbee/pdf/University%20of%20Abertay%20Dundee%20_Olisanwendu.pdf

Percival, F. and Ellington, H. (1980) The place of case studies in the simulation/gaming field. In Race, P. and Brook, D. (eds.) *Perspectives on Academic Gaming and Simulation 5*; Kogan Page, London.

Percival, F., Ellington, H.I. and Race, P. (1993) Handbook of Educational Technology (3rd Edition); Kogan Page, London.

Prensky, M. (2001) *Digital Game-Based Learning*; McGraw-Hill, New York.

Race, P. and Brown, S. (1998) *The Lecturer's Toolkit*; Kogan Page Ltd, London

Simpson, E. (1997) Project Management: Selecting an appropriate procurement strategy; Television Education Network

Simpson, E. and Ogwuda, O. (2004) Peer Support Equals Successful Study. http://www.cebe.ltsn.ac.uk/learning/casestudies/case_pdf/EddieSimpson2004.pdf

SLICE (Student-centred Learning in Construction Education) (2002) *Handbook on Student-centred Learning in Construction Education;* University of Plymouth; Plymouth.

Stretch, D.C. (2000) Simulation Design. In Saunders, D and Smalley, N (eds.), *Simulation and Gaming Research Yearbook*; Vol 8 (2): pp 33-46

Thiagi, S. (2004) *How To Design an Effective Training Game in 10 Minutes*. On-line course available from the official website of Sivasailam Thiagarajan: http://www.thiagi.com/

Trowler, P. and Cooper, A. (2002) Teaching and Learning Regimes: Implicit Theories and Recurrent Practices in the Enhancement of Teaching and Learning Through Educational Development Programmes. Higher Education Research and Development 21 (3): pp 221-240.

Twelker, P.A. (1971) Simulation and media. In Ellington, H. and Earl, S. *Using Games, Simulations and Interactive Case Studies*; SEDA Paper 101; SEDA

Wentworth, D.R. and Lewis, D.R. (1973) A review of research on instructional games and simulations in social science education. *Social Education*; May.