

# APPROACHES TO DEVELOPING EDUCATIONAL RESEOURCES USING AI EMBEDDED IN COMPUTER GAME TECHNOLOGY. A CASE STUDY: PRIMARY SCHOOL LITERACY.

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## ABSTRACT

*In this extended abstract, we discuss recent research at Worcester into the inclusion of AI into 'Serious Games'. Serious Games research intends to harness the power of computer game technology to produce educational and training materials. We prefer the name 'Immersive Environments' (IEs) since this emphasises the human psychological dimension. Creation of compelling and convincing learning software requires a rich engagement of the learner, and a convincing learning experience. We believe that various aspects of the AI tradition can inform the production of such learning.*

## Keywords

*Computer Games, Serious Games, Computer Aided Learning, Adaptive Learning, Collaborative Learning*

Research into Serious Games has produced many interesting prototype applications. These have developed training materials for the military and rescue services. At Worcester, we focus on education, at both Primary and Secondary levels. Our recent published work has addressed issues of Secondary Physics education, the use of IEs to provide an alternative to linear PowerPoint presentations and applications for the training of architects. Our current research focuses on Primary School music education, and in particular the development of IEs to support the learning and teaching of literacy at Key Stage 2. This is grounded in the National Literacy Framework, and more specifically in the 'VCOP' (Vocabulary, Connectives, Openers, Punctuation) methodology developed by Ros Wilson, and adopted by many primary schools.

Computer game technology as realised in our IEs presents the learner with a compelling and familiar educational experience. Youngsters are familiar with computer games and engage with these. They

are a part of their current 'technology vocabulary' and daily play activities. What better to harness their language and enthusiasm in an educational context?

Our research intends to bridge the gaps between computer game technology, pedagogical theory and those concepts and processes familiar to AI. The goal is to provide rich, interesting and valid educational experiences, realised through computer game technology.

This paper discusses our approach. We provide an overview of our guiding theory and an example of its application in a Case Study focusing on Primary Literacy education at Key Stage 2. Our approach uses principles drawn from concept maps and architecture theory to inform the topological structure of our IEs. The dynamics are informed by theories of 'Experiential Learning'. We also consider the aspect of collaborative learning, where several learners may enter an IE and learn together. Also, the question of 'adaptability' is considered, where the IE changes dynamically during the learner experience according to the learning.

The design of an IE must be grounded in theory. Currently, research into 'Serious Games' has not yet converged to a theoretical base. Since IEs are in their infancy; any theory is to be researched and developed. However, since IEs are constructed to provide a realistic model of true human activity, some guiding principles clearly emerge: (i) The use of architectural principles to design a compelling spatial experience. (ii) A recognition that ideas distilled from studies of perception and the human visual system are relevant. (iii) The psychological dimension, addressing concepts of learning and interaction. This is the basic triad we have adopted

to inform our research. We discuss these issues below.

An IE is to be constructed in a four-dimensional Einsteinian space and time. Learners wander through the IE, moving through space and experiencing activities in time. How can we structure this four-dimensional space to assist the learning process? One approach we have researched uses 'Concept Maps' to structure the spatial topology of our IEs. The IE rooms and terrain locations are fabricated according to concepts and relations between these. Each concept is associated with a space, connecting passages serve as a metaphor between relations. The temporal dimension is informed by theories of experiential learning, e.g. Kolb's cycle.

The system is configurable by the teacher and adaptive to the learner. This is achieved by connecting the IE rooms with doors that can be open or closed depending on the teachers' lesson plan or the learner activity. This imparts a measure of non-linearity to the system, expanding beyond a pure sequential mode of instruction.

Our IEs typically contain a number of non-player characters (NPCs). These are used to provide several functions, such as guiding the learner through the IE rooms and providing assistance when called upon. NPCs can be coded in various ways to display intelligence. We have used both rule-based systems and artificial neural networks. In the latter, an expert traverses the IE, his/her perceptions and actions are recorded, and these inputs and outputs are used as a training set for an 'offline' neural network. This network is then used to control an NPC which replaces the human expert, taking on the role of the 'teacher' within the IE.

The development of computer games has until recently been dominated by the production of high-quality visuals and rendering. This is now taken for granted. We focus on the use of this technology to interact with the perceptual system of the learner, through various forms of interaction. These involve visual output to the learner and mouse and keyboard input. The feedback loop established by these has been optimised to maximize information throughput, through, e.g., minimization of keystrokes. We have considered the nature of visual information presented to the learner, from content matter to navigational cues. Objects (words and punctuation) can be selected using a cross-hair with the mouse and assembled into sentences which are checked for correctness.

One aspect we have considered, but not yet researched is the use of our IEs in a collaborative mode of learning. Here, several learners will enter the IE and, equipped with headsets, will be able to learn together, guided by intelligent NPCs.

Our IEs are being developed with input from teachers at a local primary school. Their expertise is informing the system in a number of ways. Content is important, but also interaction. Teachers have identified several important issues such as adaptability, simplicity of the interface and the need for sophisticated visuals, such as the setting of the IE in a particular context: We chose a Roman Villa.

While our research is still 'work in progress' we feel that the principles and concepts discussed in this paper are already of general interest to the 'AI in Education' community.