Towards a Participatory Simulation Framework for potentially effective E-learning in Classroom environments

Omair Ameerbakhsh
Principal supervisor: Professor Amir Hussain
Second supervisor: Dr Savi Maharaj
My Research Question

Will the use of Participatory Simulation to teach complex systems in an e-learning environment enhance students' learning effectiveness?
Overview

- Introduction – overall aim
- Background – Learning theory
- Advantages
- Research objectives
- Research methodology
- Preliminary results
- Future work
Introduction – Overall Aim

My research focuses on the following areas:

- Participatory Simulation
- Learning Theory
- Complex Adaptive Systems
- NetLogo
- HubNet
- Clustering & Game Theory as case studies

Which will be discussed next
We aim to utilise a state-of-the-art agent-based participatory simulation framework for e-learning applications in a classroom environment.

We are initially focusing on the following e-learning case studies:

- Unsupervised clustering. (Barlow 1989a)
- Game theory. (Neumann 1928)
Background – Participatory Simulation

- Participatory simulation can be defined as:
  - When students acting out the role of individual elements of a system and then observing how the behaviour of the system as a whole can emerge from these individual behaviours. (Wilensky & Stroup 2002)
  - A form of multi-agent simulation (MAS) that allows the user to participate in a simulation run by controlling (or ‘playing’) one of the agents defined in the simulation scenario. (Wagner 2013)
Learning Theory

- Collaborative learning theory – is a situation when two or more people learn or attempt to learn something together (Dillenbourg, 1999). Participatory Simulation involves more than one participant in the simulation.

- Game-based learning theory – A computer simulation is a way of modelling a real-world situation on a computer. By altering variables, predictions about the behaviour of the system may be made. Simulations have traditionally been considered as types of games. (De Freitas, 2006)
Advantages

- Easier to understand
  - Help design agent rules
  - Make the simulation of human behaviour more accurate.
- The rules are extracted from real-time decisions
  - will be more robust than a simulation that was hand-engineered.
  - better ABS using modern AI methods.
- New paths to scientific understanding.
- Enables inquiry and experimentation
- Directly engage with the complex system at hand.
Mixed Method Research

- We will use a mixed methodology approach to validate our hypothesis.
- **Mixing Qualitative and Quantitative research methodologies** has been adopted by many researchers in interdisciplinary educational research. (Kumar 2007)
- It helps to produce a wider exchange of views and renders good quality results.
- the literature suggests that either method may satisfy the style of the reader or the beneficiary of the results; or may find the quantitative result or the qualitative result more credible (Bryman, 2004).
- The mixed methods design was chosen to provide for a more in-depth exploration of the problem then either quantitative or qualitative methods alone could produce (Creswell, 2012).
Unsupervised learning.

One of the most popular techniques in machine learning and artificial intelligence.

I have implemented a working simulation of a K-mean clustering exercise in Netlogo and HubNet.

This will be tried next week on the Information System (CSCU9T6) Module taught by Kevin Swingler.
1D Clustering on NetLogo – Screenshots
2D Clustering on Netlogo – Screenshots
HubNet 1D Screenshot
Mean of a cluster is calculated by adding coordinates of all elements in cluster and dividing by total number of elements.
Clustering on NetLogo
We will also explore the idea of implementing the use of participatory simulation in a game theory course taught by Professor Rachel Norman at Stirling University, in which we are going to look at some game theory exercises; a "Golden Balls" example, and a card game example computerised in a participatory simulation. Also, Iterated Prisoners dilemma and a "tournament" between competing strategies is another possibility. These activities could be used to complement existing tutorial activities, or as part of student projects.
The NetLogo framework currently implements a k–mean clustering simulation at a participatory level. In the future, we will be trialling the exercise on the Information system (CSCU9T6) Module students. The students will be receiving two sets of Surveys. Pre–survey before the HubNet experiment. Post–survey after the Hubnet experiment. We analyse the results of both surveys to investigate the effectiveness of the new technique. We will also compare the effectiveness of the new PS based group e–learning approach with traditional methods of teaching unsupervised clustering algorithms to assess learning aspects enhancements/capabilities of e–learners by handing questionnaires to the students.
We will also interview teachers to get their opinion about the use of Participatory Simulation.

We will implement the participatory simulation technique in a game theory course taught by Professor Rachel Norman at Stirling University, in which we are going to look at some game theory exercises.

A domain expert from the School of Education (Dr Terrie-Lynn Thompson) will advise on relevant comparative social/group e-learning evaluation aspects in the future.
Any Questions?