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Proceedings of the 20th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE)

Adelaide, Australia
7–10 December 2003

Editors
Geoffrey Crisp, Di Thiele, Ingrid Scholten, Sandra Barker, Judi Baron

Citations of works should have the following format:

Author, A. & Writer B. (2003). Paper title: What it's called. In G.Crisp, D.Thiele, I.Scholten, S.Barker and J.Baron (Eds), *Interact, Integrate, Impact: Proceedings of the 20th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education*. Adelaide, 7-10 December 2003.

ISBN CDROM 0-9751702-1-X WEB 0-9751702-2-8

ascilite
Australasian Society For Computers
In Learning In Tertiary Education

Published by ASCILITE www.ascilite.org.au

GENERATING PROFESSIONAL KNOWLEDGE BASED ON E-LEARNING RESEARCH AND DEVELOPMENT

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Abstract

Academics have designed and developed role-play simulations to provide learning opportunities for students in different disciplines for many years now. The AUTC Information and Communication Technologies and Their Role in Flexible Learning project has collated exemplars of the designs on a website (in development). Drawing on this resource, this paper sets out to synthesise the previous developments as it begins the work of theorising learning designs. In this way further understandings might be generated whilst also guiding developments in fields of study beyond the individual designs that have been reported to date.

Keywords

professional development, learning designs, role-play simulations, e-learning

Introduction

In 1929, John Dewey in his book *The Sources of a Science of Education* talked about his concern that educational research had become 'an arm chair science', removing itself too greatly from the educational practice (cited in Lagemann, 2000). What appears to be evoked in Dewey's argument for educational scholarship is an interface between educational research and educational practice in which theory and practice are inextricably related, where the 'theory and practice should be integral to one another' (Lagemann, 2000; p. 231). Taking a philosophical approach of deriving ideas from introspection ('armchair thinking') can add perspective, but to gain understanding of how something works requires an empirical, experimental (scientific) approach to 'move a topic along on sure footing' (Gazzaniga, Ivry & Mangun, 1998; p. 2). In education, as in other fields of study, philosophy as intellectual synthesis and 'the contemplation of the unknown' can only go so far - empirical testing of the worth of these ideas where 'turning as much philosophy as possible into science' (Wilson, 1999; p. 10) would appear to be a path of progression (and learning). A research and development approach which incorporates the theorising of educational practice would seem to be a fruitful way in which to move a field forward.

Hiebert, Gallimore & Stigler's (2002) assert that 'teachers rarely draw from a shared knowledge base to improve their practice' nor do they routinely use research-based knowledge to inform their work, and concurrently draw attention to the assumption that researcher's knowledge could be of value to teachers in its 'generalizable and trustworthy (scientific) character' whilst the knowledge teachers use is often considered 'craft' knowledge, 'characterized more by its concreteness and contextual richness than its generalizability and context independence' (p. 3). The gap between what knowledge informs the work of teachers and improves the educational process for learners and the impact of research findings on educational reform seems to be apparent - a chasm between the two communities of research and practice. Taking up the challenge to breach this divide is an approach that is driven by practitioners' agendas: 'Is there a road that could lead from teachers' classrooms to a shared, reliable, professional knowledge base for teaching? ... What would the road look like?' (Hiebert et al, 2002; p. 4). The shift from practitioner

knowledge (which is linked with practice; is detailed, concrete, and specific; is integrated) to a professional knowledge base in education (which must be public; must be storable and shareable; requires a mechanism for verification and improvement) is explored by Hiebert et al (2002).
This paper forms the first part of an e-learning research and development agenda to generate professional knowledge by addressing the question: In what ways might a practitioner draw on the experiences and research of other teachers to inform the development of an ICT-based learning design in higher education? This question was addressed through a detailed analysis of one particular learning design, the online role-play simulation. Though subsequent parts of the study have already been undertaken they will not be reported here. In these cases, the questions being investigated are a variation on questions researched in an earlier CAUT study (Alexander & McKenzie, 1998): How does a practitioner select to use a particular learning design in their teaching, and how do they develop the design parameters? What has the introduction of an ICT-based learning design contributed to student learning in higher education? What are the ways in which a teacher can know what and how students have learned in a particular learning design? The research and development pathway undertaken in the three-part study attempts to stay firmly grounded in responding to and interacting with the varying cultural and institutional needs of educational practice whilst being driven by a scientific inquiry approach.

‘Diving-in’: Setting a learning agenda

This study was initiated by a broad exploratory interest in learning designs and by an invitation to participate in a *National Summit on Online Role Play Design* (Institute for Interactive Media and Learning, University of Technology, Sydney). What was to follow was a deep engagement with the role-play simulation section of the *ICT-based Learning Designs* website (part of the *AUTC Information and Communication Technologies and Their Role in Flexible Learning* project) in a bid to develop an understanding of a particular learning design for teaching and learning in higher education. After becoming familiar with all seven role-play simulation learning designs on the website, four were selected for detailed analysis on the basis that there appeared to be similarities in how the designs were conceptualised. Following this decision, all published and other secondary data sources that were available for these four designs were collected and analysed. The approach taken was to firstly locate in these sources all the comments that students had made about their experiences. These selections were then categorized according to broad common features and an interpretation of these grouped excerpts was written. The next task was to read through these same data sources but in this case to observe and distil what the designers had built into the role-play simulation environment and the way in which they described the learning design in their field of study. An interpretative summary of each of these features was made and the source data was revisited to find further evidence that supported these commonalities.

Role-play simulations: Making sense of the learning designs

The four role-play simulations selected as cases for analysis were:
- Middle East Politics (Vincent, Shepherd & Viet)
- Mekong e-Sim (McLaughlan, Kirkpatrick, Maier & Hirsch)
- Environmental Decision-Making (Brierley, Hillman, Devonshire & Funnell)
- Securities Markets Regulation (Freeman & Adams)

The designs were analysed in this phase on the basis of their function - why did the academic designer in each case choose the specific learning design of a role-play simulation in which to embed experiences in a particular field of study? The themes that were salient and seemed to be of importance to the designers themselves were identified, though no attempt was made to second-guess the designers’ interpretations or to critique their designs. The task was to select, analyse and describe the commonalities between designs as a starting point, well knowing that ‘while all science begins with description, the making of lists describing the phenomenon we wish to understand, no matter how detailed, is not enough in any science, including the human sciences’ (Plotkin, 2002; p. 9). What was to emerge was that each role-play simulation engaged students with experiencing complexity in a context that in some way mirrored

professional practice and where different dimensions and discipline perspectives (as well as individual beliefs, interests and values) were interacting dynamically over time.

Engagement with complexity

All four role-play simulations describe students interacting with various forms of complexity that might be present in their professional fields of practice as graduates. The contexts in which the role-play simulations are situated, and the issues that students explore, are expressed as being contemporary and topical. Students seem to be immersed in experiencing complexity as emergence, uncertainty, and as interactions between various components (which includes the ways in which these impact on each other).

- In the case of *Middle East Politics*, this complexity is described as being evident in controversial and complicated political topics under study wherein ideas and cultures unrelated to students' life experiences in the Australian context operate and interact within the 'inherent complexities of social systems' (Alexander & McKenzie, 1998; p. 70). The designers perceive that by using this learning design in an area of study which is a challenge to understand (even media sources are observed to communicate often superficial and biased reports that indicate the issues are not fully understood), that students through their learning interactions might 'mak[e] ... sense out of this constantly changing kaleidescope' (Vincent & Shepherd, 1998).
- The *Mekong e-Sim* focuses on the many development proposals that are submitted for this region which outline how the landscape might be developed. The complexity is described in the 'significant environmental and social consequences' of the decision making process and the emphasis is on understanding the costs involved in utilizing the undeveloped resources for economic benefit in parallel to the social consideration of improving the quality of life for people in the region (Mekong e-Sim Student Handbook 2002).
- The *Environmental Decision-Making* simulation studies an inland river system in Australia whose features are described to students as being those of complexity and variability and where there is a high degree of uncertainty associated with the management decision process. What is fore-grounded to students is that even though decision making under these conditions is difficult where there are not clearly defined outcomes, and though they may be uncomfortable working with this uncertainty, it still requires them to take action (GEO328)
- The *Securities Markets Regulation* role-play simulation explores the contrasting views that interface with the regulatory nature of securities markets. The complexity is described in the ways that the different approaches of law and finance influence and are part of a fluid process (Freeman & Capper, 1999).

Different dimensions and inter-disciplinarity

All four role-play simulations acknowledge the different dimensions and inter-disciplinary nature of authentic contexts and build this explicitly into the learning design. There are three ways in which this operates: in most cases the students participating in the role-play simulation are themselves from different discipline areas with a range of prior experiences and knowledge; in all cases, the inter-disciplinary nature of the simulation is designed into the environment through the roles that are selected and assigned, and; in all cases the scenarios introduced into the context require that different dimensions be considered in the way students interact and implement a course of action.

- The aim of the *Middle East Politics* simulation is to engage undergraduate and postgraduate political science students with personalities that are prominent in the Middle East political situation. Though students are mainly from the Arts and Humanities, students from other disciplines (e.g. Science, Economics, Engineering) can enrol in the subject. The created roles include prominent political, religious and social leaders from countries such as the Middle East, Europe and the United States, as well as media roles (e.g. BBC, CNN, New York Times).
- The *Mekong e-Sim* is designed so that engineering and geography undergraduate students would collaborate in an authentic setting 'on understanding development needs of the region and issues related to engineering and technological approaches' (Mekong e-Sim Student Handbook 2002). In the course of these interdisciplinary interactions and the scenarios, the students could engage in 'consideration and adoption of multiple views (i.e. economic, social, technical and political dimensions) of issues relevant to development and technology within the region' (McLaughlan, Kirkpatrick, Maier & Hirsch, 2001).

- In the *Environmental Decision-Making* simulation, undergraduate physical geography students are exposed to genuine ecosystem-based management. The designers view these ecosystem models as 'holistic and multi-disciplinary and incorporate stakeholder and institutional factors in the analysis'. By undertaking a multi-disciplinary approach which incorporates all stakeholders, students could experience how this might hedge the chances of successful and just decision-making in an uncertain domain (GEO 328).
- In *Securities Markets Regulation* postgraduate students in Business and Law are brought together to take on roles that include major political, legal and finance figures involved in the process of regulating the Australian securities markets. In parallel, press release scenarios relate to 'several types of political, financial and legal information signals and crises in the securities markets' (ICT-based Learning Designs website).

Differing beliefs, interests and values

Though expressed in different forms, all four role-play simulations highlight the potential for conflict because of the different values, beliefs and interests present in the complex and often volatile situations in which the role-play simulations are situated. Set out as learning outcomes, designers believe that decision-making processes, being able to maintain relationships or adopting conflict resolution approaches are important skills for students to learn in their discipline fields and that participation in a role-play simulation could be an appropriate and effective way in which students might learn these skills. The development of an awareness of and appreciation for different viewpoints present in different environments seems to be fostered.

- In *Middle East Politics* students are exposed to cultures that are alien, 'with leaders and actors whose actions and motives seem inexplicable' (Vincent & Shepherd, 1998). The opportunity to consider what drives other ideologies and agendas appears to be highlighted and lead towards 'an appreciation of the many grey areas that dominate people and politics, as well as looking below the surface and going some way to understanding different views' (http://www.mq.edu.au/mec/sim/role.html).
- The *Mekong e-Sim* involves taking into account the six countries situated within the Mekong River Basin, all of which have distinctly varying values, interests and belief systems. Since this region is still developing a sustainable economy, this results in many conflicts, with 'highly charged debates over development issues arising from clear-cut differences and conflicts in values and interests' (McLaughlan et al, 2001).
- In *Environmental Decision-Making* the aim is to involve students in dealing with situations that call for conflict resolution focusing on consensus over compromise or majority in the environmental decision-making process. This is in recognition that these contexts often entail differing multi-disciplinary interests with both individual stakeholder and institutional factors that need to be considered during the analysis process. The value that might be attributed to particular types of information (e.g. academic reports versus local knowledge) and the tensions that might arise over this is considered (GEO 328).
- The designers of the *Securities Markets Regulation* simulation note that they bring together two conflicting paradigms that operate in this real world context - that of law which is underpinned by an approach of equity and that of finance where efficiency solutions are the primary drivers (Freeman & Capper, 1999).

Dynamic system of interactions

In all four role-play simulations, built into the designs is the opportunity for students to experience the developments (including issues and incidents) as emerging over time in response to conditions that are occurring in the wider cultural context of the simulation as events, or as a consequence of the interactions initiated by students themselves that are unfolding within the system as the simulation progresses. These interactions include different ways in which students might operate in this emerging process (e.g. through collaboration, secret negotiations, consensus seeking discussions, debate, political maneuvering).

- In the *Middle East Politics* role-play simulation students have the opportunity to learn 'about the inter-relatedness of events. How if something happens in one area, it's going to have flow on effects to other areas. They learn about decision making and how stress can play a role in politics and in international relations' (http://www-jime.open.ac.uk/98/11/vincent-movie.html). The coarse texture of

these interactions is that 'essentially, students play their roles themselves, without outside assistance. We have found that the teams tend to be largely self correcting, through the other team members, and the other players in the game' (Vincent & Shepherd, 1998). From a teacher's perspective: 'I've had to learn to relinquish some control over the learning environment. I have to allow the process to move in unexpected directions and step back and just let things run. At the same time, I have to be ready to handle unexpected situations that may arise during the course of a simulation' (Maher, 1999).

- The *Mekong e-Sim* is designed so that students could interact with each other and engage in collaboration and where social, political, economic, scientific and conservation based conflicts that might emerge during the simulation place students in a position where they can participate in the 'hypothetical management of some of these conflicts' (Mekong e-Sim Student Handbook 2002).
- In the *Environmental Decision-Making* simulation, the importance of 'a participatory approach to resource and environmental management' was emphasized, based on arguments that a more just decision-making process would involve all components and parties who had interests in the system rather than a focus on 'one or two parts which are subject to political bias and the promotion of iconic parts of the ecosystem'. The uncertainty in this context was balanced by adopting an 'adaptive management approach' (GEO 328).
- Through interacting in unfolding and unfamiliar scenarios in the *Securities Markets Regulation* role-play simulation, the designers perceive that students could perhaps learn 'to deal with pressures of time and public reaction as well as learning to represent complex organisations' (Freeman & Capper, 1999). The designers outline the view that there is 'no one right answer, but a range of means of engagement in working towards a resolution' (Freeman & Capper, 1999).

Mirroring professional practice

The role-play simulations attempt to mirror in some way a professional context of practice, melded with an analytical, questioning approach to the decisions that are being made and the path of progress that is being undertaken. Students are encouraged to reflect, examine their actions and interpret the system. Vincent elaborates on the connections between a simulation and actual professional practice: 'I believe skills students learn while participating in the simulations (thinking on one's feet, formulating convincing arguments, dealing diplomatically with individuals from different backgrounds and with opposing views) are applicable to just about every profession' (Maher, 1999).

- The designers build in different modes of communication that students might use in order to participate in the *Middle East Politics* simulation and they state their rationale for this succinctly: 'Political dialogue is carried out at a number of levels in real life, and the role-play simulation attempts to provide analogues to the most widely used forms of communication' (Vincent & Shepherd, 1998). Students are also advised: 'This is much like real life ... things rarely go the way we planned them - and you are expected to cope with unexpected, difficult circumstances (and marked according to how you cope, not how you complain)' (http://www.mq.edu.au/mec/sim/email.html).
- The designers of the *Mekong e-Sim* express this mirroring clearly: 'Mekong e-Sim was intended to provide a rich and authentic learning environment in which students would engage in meaningful tasks that directly contributed to their learning of substantive content and encouraged the development of generalisable skills ... and understandings ... Finally the collaborative online tasks ... assisted in preparing students for requirements of today's global industries' (Kirkpatrick, McLaughlan, Maier & Hirsch, 2002; p. 14).
- In the *Environmental Decision-Making* debrief documentation students are alerted to the ways in which 'solutions' are arrived at in the course of the role-play simulation, signaling that there were no 'right' answers in these circumstances. During the debrief analysis, the designers explicitly state that what actually happens is the 'product of a particular set of personalities, information, and group dynamics. Another day may have produced another outcome. Such is the uncertainty of environmental decision-making' (GEO 328).
- The press release scenarios that are introduced in the *Securities Markets Regulation* simulation are designed 'to ensure realistic and relevant dilemmas' (Freeman & Capper, 1999). In response to this feature - the realistic portrayal of possible world events - the designers observe that some of the events have since happened.

Learning view: Hearing students talk about their experiences

Evaluations of role-play simulations are commonly undertaken to ascertain whether the learning outcomes have been met and to plan revisions to learning activities where feedback from these evaluations indicates a priority. Interspersed within the evaluations carried out of the role-play simulations under study is limited data about how students actually learn what it is that is embedded within the designs. The excerpts highlight a need for greater understanding through empirical study of the learning opportunities and developments afforded for students engaged in these learning environments. Consequently, rather than critiquing the data collection of these evaluations, the approach is to select aspects from the publicly available findings that appear to be salient and to provide fruitful pathways for exploration. In this way, the purpose is to investigate whether an analysis of this limited data might highlight any lines of inquiry that could illuminate how students operate in these contexts and the ways in which they might be learning. Herewith is a summary of those findings:

Whilst engaged in the role-play simulation, students seem to be identifying that they are learning in ways that are different to other experiences in higher education learning. They appear to be gaining an understanding through the unfolding process of action, where knowledge of the professional field is drawn on and tested for its value *in situ*. There seems to be a sense that students are generating possible effective paths to action informed by this knowledge and experimenting to see what happens.

- *brought it all together, in a novel way ... very different to my normal way of learning, it wasn't memorising* (Freeman & Capper, 1999).
- *Rather than just the theory in a textbook or a set of readings on what somebody has to say, we're actually put into that role. We were doing it ourselves. So by trial and error and through everything else, I think we learnt more than we could in reading anything* (http://www-jime.open.ac.uk/98/11/vincent-movie.html).
- *It was an incredibly organic, 'natural' way to learn. The insight gained would not have been possible in a straight, text-based course* (Wills & McNaught, 1996).
- *My reaction to the role play was - I was excited about it because it wasn't an exam. Whilst we were getting some guidance and we were given some guidelines from the lecturers it still was not enough to make me feel comfortable with the whole thing. But then moving myself out of my comfort zone is how I know I am going to work well anyway. So I set deadlines - I am going to be a journalist - so by 10 or 11pm each night when the press releases were issued I posted what I called 'Gottliebsen's View' which was a commentary of the events of the day. I also as the role play went on started trying to talk to others and generate interviews with what I referred to as my 'highly acclaimed series of interviews with very important people'* (ICT-based Learning Designs website, in development).
- *The Internet allowed me to keep up-to-date with my character and let me know how he would act or behave, I also tried to analyze just how the he would think/react to future events that hadn't occurred before* (Maher, 1999).
- *You learn a lot about ...the whole field of politics and interactions ...You can study until you are blue in the face but until you have a practical implementation of what you're studying, you won't understand* (Alexander & McKenzie, 1998; p. 76).

Students seem to be describing their engagement in learning experiences where quite different (and sometimes foreign) interests, values and beliefs are present. In particular, it appears that in these contexts the value and belief systems of the role they are playing and their own personal beliefs and values are salient, are being examined and are interacting with each other in the action of the role-play simulation. At times the moral dimension of the different situations is being viewed and seems to come into consideration when decisions are being made.

- *The one thing that is an overriding feature I got out of SMR in general which really got brought home in the role-play was ethics, because as a journalist I had a lot of opportunities to screw people. I could have twisted people's words. Prior to doing SMR I had never really considered ethics, it was always a big part of me without me realizing it and now it is a real feature, I am thinking about it quite a lot. I was able to appreciate that in the real world, trying to ring someone up, going to lunches and dinners, you would always be working so it is not just a big junket trip.... I think that is where I gained a real appreciation* (ICT-based Learning Designs website, in development).

- *Thus, a personal moral judgment becomes imbedded in the virtual world of the esim . It was very difficult not to impose my own views on conservation and environmental management onto that of [my role]. In some ways I was not successful in my attempt to keep them separate, which surprised me, as I had assumed that I would be able to maintain dual views* (Mekong e-Sim student feedback).
- *I really felt the sense of frustration of trying to maintain my character's goals while keeping aligned with our country* (Maher, 1999).

Students appear to be exploring what determines the ways in which people from diverse backgrounds think and the actions that they take. They seem to be unravelling the influences that shape how people use their knowledge and understandings in different contexts and under different circumstances. It seems that students are becoming aware that different beliefs, understandings and values come into play in decision-making, and that in gaining this understanding they are starting to recognize the importance of how this informs their interactions with others in various situations. The way in which these multiple points of view that differ to one's own are being reconciled in a context of action, and how one operates in these situations, appear to be part of the students' learning in these role-play simulations.

- *Putting yourself in someone else's shoes - you may get a role of a particular character but you don't necessarily agree with them but you have to try to develop their mindset ...It's imperative to be able to see other points of view and realise that they're just as valuable as yours* (Alexander & McKenzie, 1998; p. 77).
- *very educational in terms of how it must be to have to participate within a political party where variants upon an ideology must be somewhat reconciled* (Alexander & McKenzie, 1998; p. 78).
- *It's a lot more complicated than it seems and people generally do have, you think 'oh it's terrorists, they have no backing, they're just trying to kill people' but they actually have a basis for what they're trying to do* (http://www-jime.open.ac.uk/98/11/vincent-movie.html).
- *When you play different groups in the region, you have to find out about them and what their goals and strategies are and where they're coming from, their sort of history and experience* (Alexander & McKenzie, 1998; p. 72).
- *You really learn to sympathize with the people's causes and issues, how they feel or react, also how politics works and how strongly issues (i.e. terrorism) are dealt with internationally* (Maher, 1999).
- *Before [the role simulation] I focused on the finance side ... how the markets work ... but I didn't really see the regulation side. Now I can see the regulators, what they are going through* (Freeman & Capper, 1999).

Students appear to be responding to the way in which their decisions and actions need to adapt to the changing conditions of the context. Unlike other learning activities in which they have participated, within the role-play simulation there are no predetermined or simple, set answers. At times, the changes that are occurring in the social context of the role-play simulation experience draw students' attention to the pace of the action and the complexities of the interactions.

- *An essay doesn't change whereas the questions we needed to answer fluctuated daily* (Vincent & Shepherd, 1998).
- *It enhanced my understanding of all politics, how fast-moving it is and how situations change at a rapid pace* (Maher, 1999).
- *I don't think I will ever look at any political situation again and take it at face value. There's so much involved under the cover of what's happening and you read between the lines ... I mean, we all see the solutions and say, 'Why don't they do this?' or 'Why don't they do that?' But when you're actually here and everyone's in character ... you see how difficult it is and how almost impossible to implement a seemingly easy solution into a complicated situation* (Alexander & McKenzie, 1998; p. 77-78).

Students seem to be gaining an understanding as to the nature of interactions within a dynamic system where each action influences others and the elements present are inter-related. They appear to be considering how one might engage in this kind of system - what strategies might one put into place and why this might be the case for an effective course of action.

- *you have to be careful what you decide, what effects it's going to have upon the region and you have to know what's happening in other parts - like if you're on the border and there are problems or conflicts or whatever* (Alexander & McKenzie, 1998; p. 72).

- *simply by summing up the attitudes and direction of the previous three weeks, and determining where these might, or should, lead* (Alexander & McKenzie, 1998; p. 73).
- *we researched issues which were likely to be raised and 'our' current position on them - we would not waver* [Students talking about ways of preparing for the teleconference] (Alexander & McKenzie, 1998; p. 73).
- *you have to be careful in planning your strategies and you always have to look, to negotiate in secret like when you're consolidating views with people* (Alexander & McKenzie, 1998; p. 72).

Students appear to be exploring the interface between the role-play simulation and the real world context. They seem to be questioning what drives the action and beliefs present in world events and everyday happenings, and the interpretations or representations that are made of these events. The way in which their experience within the role-play simulation influences how they subsequently view and understand the discipline knowledge in real world contexts appears to be highlighted.

- *There are lots of things that go on behind the scenes that most of us never consider. Now, when I read the newspaper, I think about what had to happen to get to this point and what is still going on that isn't clear on the surface* (Maher, 1999).
- *It especially brought to light how hard it would be to make certain decisions in real life. It is so hard to please everybody* (Maher, 1999).
- *I have been here 5 years and never watched the [federal] budget with so much interest ... I just sat down and I knew the budget just like that* (Freeman & Capper, 1999).

Discussion: 'Stepping-out'

In the course of attempting to understand the ways in which role-play simulations might provide qualitatively different learning experiences in higher education and throughout the immersive experiences in the data sources available for the four cases, one central theme has vied for continual attention - the idea that role-play simulations are designs that embody complex dynamic systems in a particular domain. The various common features that are identified and evident in the role-play simulations of this study appear to be subsumed within the complexity that is built into this learning design and to be entwined within the environment as different dimensions or opportunities. Thelen & Smith's (1994) description of a complex dynamic system gives a vantage point from which to observe the parallels with what teachers design into their role-play simulation environments and what students perceive in their experiences of such environments:

> Although behavior and development appear structured, there are no structures. Although behavior and development appear rule-driven, there are no rules. There is complexity. There is a multiple, parallel, and continuously dynamic interplay of perception and action, and a system that, by its thermodynamic nature, seeks certain stable solutions. These solutions emerge from relations, not from design. When the elements of such complex systems cooperate, they give rise to behavior with a unitary character, and thus to the illusion of structure. But the order is always executory, rather than rule-driven, allowing for the enormous sensitivity and flexibility of behavior to organize and regroup around task and context (p. xix).

By further extracting and refining what is observed in the four role-play simulations and what is salient in this study, an attempt is now made to begin to understand why specific design features (identified within this complex dynamic system perspective) might enable learning in these environments.

Variation and diversity

At the cultural level, variation and diversity is evident in the *different dimensions and inter-disciplinarity* that is built into the role-play simulations. In parallel, the variation at an individual level is clearly visible in the *differing beliefs, interests and values* that surface during the running of the design through the roles students take on and which they themselves bring to the learning environment (though what seems to be absent is consideration of how students' own diverse values might be driving their learning agendas in these contexts). Multiple perspectives and seeing from somebody else's point of view are given high value as learning experiences within role-play simulations by the designers and students recognise that

'walking in someone else's shoes' enables them to develop greater understanding of how decisions are made in complex situations.

Ideas and concepts that are of value in a field of study (and somewhat difficult to understand) are designed and built into the role-play simulations in ways which are sensitive to how learners might gain access to them as they work towards generating their own understandings and development of the ideas within various contexts. The different ways in which knowledge might be used by different discipline agendas is recognized, and opportunity to experience this variation in perspective is explicitly embedded in the role-play simulation for learners to engage in 'participatory, experiential modes of thinking' (Resnick & Wilensky, 1998; p. 154). This is in contrast to the transmissive and delivery modes of learning experiences, and where in some cases teaching abstractly (without diverse representations of the concepts) appears to lead to knowledge that 'displays a 'brittle' character, usable only in the exact context in which it was learned' (Wilensky, 1991; p. 195). The variation present in a multi-disciplinary approach, where the 'richness of ... presentations, interactions, connections with the objects' enables a concrete way of knowing (Wilensky, 1991; p. 198), seems to suggest that students might be constructing relationships with the objects of knowledge within role-play simulations which are quite different to how students might learn in a lecture. Knowledge in this concrete form seems to have a greater emphasis on relationships, on 'connected knowing' where access to and selection of other people's and a discipline's knowledge is driven by an individual subjective need to know (Belenky, Clinchy, Goldberger & Tarule, 1997) and where learning involves 'incorporating the thing known into the knower' (Plotkin, 1994; p. ix).

Emergent development

In observing the *dynamic system of interactions*, where interrelated events are happening over time which shape opportunities for development within the designed environments, what comes clearly into sight is the epigenetic nature of interactions evident in the running of the role-play simulations. Using human development as an analogy provides a helpful way of viewing this process and recognizing the similarities in explaining the developmental aspects that are noted in the role-play simulations of this study:

> Development is not an automatic, pre-ordained unfolding process which, once initiated, proceeds to the completed state of the adult organism. Rather, each individual is, in a real sense, created anew, the unique outcome of an immensely complex series of interactions between the different parts of that individual; and also between its genes, its developing parts and its environment. Epigenesis is the word used to describe this complicated, integrated, dynamic and probabilistic process of development (Plotkin, 1994; p. 122).

Implicit in this perspective is a sense that within the design of rich complex environments such as role-play simulations there are no right or wrong answers but rather a means that enable individuals (through interaction with their environment) to choose their own pathways based on their own developmental histories and where events occur in relation to what has taken place previously. As part of this process, mechanisms are built in that lead to progression, to a 'self-sustaining, self-improving system' (Kelly, 1994; p. 3). Learners within the designed system are supported to move beyond 'deterministic and centralized ways of thinking' (Resnick & Wilensky, 1998; p. 156) to where they can select and test their own developing ideas in the safe environment of a decentralized learning system. The selectional process seems to be driven or underpinned by a generate-test-regenerate mechanism (Plotkin, 1994) and can be described as a learning heuristic that 'leads to discovery and invention' (Plotkin, 1994; p. 250). In such a way, knowledge learning as operationalised in the role-play simulation design 'is not a thing, but a continuous process; not a structure, but an action, embedded in, and derived from, a history of actions' (Thelen & Smith, 1994; p. 247).

Mirroring analogy

In a sense, by *mirroring professional practice* in the role-play simulations, a 'lived-in' analogy is created wherein events that students experience in the designed environment are often examined with great intensity where they correspond with events in their everyday life. This to-ing and fro-ing between the world of the role-play simulation and their own personal world - between action and perception, between that of experiencing (where testing seems to be occurring) and that of thinking (where individual

introspection appears to be taking place) - seems to resemble what Ackermann (1996) terms ‘a dance between diving-in and stepping-out’, a process that enables learning:

> People cannot learn from their experience as long as they are entirely immersed in it. There comes a time when they need to step back, and from a distance reconsider what has happened to them. They must take on the role of an external observer, or critic, and they must revisit their experience ‘as if’ it were not theirs. They need to describe it to themselves and others, and in doing so, they will make it tangible (p. 28).

When students place their thinking and knowledge in a dynamic public forum as part of a system, a hive (Kelly, 1994) in these ICT-based learning designs and where the interactions that occur in response to what is happening in the system are captured and are no longer transient, a different way of viewing knowledge and tracking development becomes possible. Learning from experience no longer relies on memory alone but can now be examined in various technological forms and analysed within wider developmental and contextual parameters. The ‘stepping-out’ in these designs is supported by the technological environment itself where a record of the interactions and an interface that is not based on immediacy of response enables the opportunity for reflection in various forms. As Ackermann notes:

> Once projected out and ‘objectified,’ personal experience can be newly reengaged. People can dive back into the situation of interest to them and get immersed at the cost of losing themselves one more time, until they eventually reemerge and, once more, look at things from a distance. It is this dance between diving-in and stepping-out that keeps us connected, while at the same time, enables us to grant the world an existence that goes beyond momentary relation with it (1996; p. 28).

Complexity itself

The role-play simulations in this study built rich, dynamic systems so that students might experience *engagement with complexity* as evident in the natural world. It is this complexity and variation, which is built into and adapted over time as part of the system itself, that enables a selectional process to flourish. Students in turn perceive that their experiences in these designed environments resonate with their natural way of learning. When learning in these role-play simulation designs is underpinned by a selectionist approach, as it seems to be, then the emergence of creativity and the generation of knowledge becomes possible. This is quite different to an instructionist approach that seems to be undertaken in some learning designs in higher education. Plotkin (1994) makes the clear distinction between these two approaches when he talks about intelligence:

> Intelligence ... does not involve just the faithful tracking of changing events. It involves also the production of novel solutions to the problems posed by change - solutions that are not directly given in the experienced world. What such novelty means is the contribution to that intelligence, to knowledge, by factors internal to the knower and hence unique to that individual intelligence. Such creativity cannot occur if change is slavishly tracked by instructionalist devices. So what we see here is that while selection can mimic instruction, the reverse is never true. Instructional processes can never lead to creativity. Instructional intelligence comprises only what has been actually experienced. To go beyond experience requires the generation of something from insider the knower, and only an intelligence driven by selectional machinery can do that (p.172).

Learning within role-play simulations does not revolve around the transmission of knowledge. Rather, a student searches and selects knowledge from within or outside the system to inform decisions, to create, and to adapt to the changing conditions within a particular context. In this process, individuals learn and develop their own understandings as well as influencing and impacting on the system as a whole over time, generating knowledge and enabling progression.

Conclusion

This study has tracked the ways in which one practitioner (myself) has gained access to the knowledge and work of other teachers and designers in a field of interest so as to inform her own professional development. The work done by these teachers in the development of role-play simulations (and publicly

available in a storable, shareable form) has provided varied sources of data. This in turn has enabled me to pose my own questions and search for patterns and features of this particular learning design. By synthesizing and undertaking some 'armchair thinking' I have been about to further distil what I perceive at this stage to be a useful model with which to think about role-play simulations. I am able to speculate and make tentative predictions as to what might be happening in environments such as those analysed in this study and I am in a position where I can begin to frame design parameters that would hedge the chances that students might experience successful learning within a particular role-play simulation design. It is on this basis that I will be able to test the predictions by operationalising and analysing this design in my field of teaching thereby initiating 'a mechanism for verification and improvement' (Hiebert et al, 2002). It would appear that a strong foundation has been set on which to generate professional knowledge. The research and development agenda now also takes up Resnick & Wilensky's (1998) challenge that '... there is a need for more in-depth empirical study of how and what people learn as they participate ... in particular, a finer-grained micro-analysis of participants' learning paths as they participate in - and engage in thinking about - complex systems. There is very little research in the developmental and cognitive psychology communities on how people make sense of complexity' (p. 170). The question is subsequently asked: What insights can role-play simulations provide into how students learn in complex decentralised learning designs?

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