An Orientation and Roadmap to Simulation and Gaming

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Abstract

Simulation and gaming have a rich and long history in the fields of organisational theory and social policy. Simulations have been applied in a variety of ways and to achieve myriad different purposes. They have been used for pedagogical purposes in under-graduate, post-graduate and executive education. They have been applied in a variety of domains such as agriculture, landscape dynamics, natural resources management and strategic management, as a form of social learning and to contribute to policy development and implementation. Other areas of simulation use have been in the domain of organisational learning and change. Although not quite as common, simulations have been utilised as an additional method of research, especially in relation to theory building and testing. Given this wide and disparate purposes and applications of simulation, it appears quite confusing and complex to researchers who may wish to benefit from the field. At a theoretical level, this paper seeks to provide an ordering mechanism to help make sense of simulation and gaming, their objectives, essential components and relationships between them, strengths and weaknesses, design approaches, modalities and deployment. At a practical level, the paper offers suggestions on whether to utilise simulations and when, the importance of the various phases of running simulations, the significance of debriefing, and drawing relationships back to real world contexts. It is anticipated that the paper may serve as roadmap for those who wish to apply simulations in a variety of contexts including teaching and learning, social policy, change management, and problem solving and decision-making in complex and uncertain contexts.

Keywords: Simulation and gaming, change management, social learning, complexity.

Introduction

Thiagarajan (2003: 235) defines a simulation as 'the representation of the objects, characteristics, behaviours, and relationships of one system through the use of another system, which contains play objects, goals, rules and roles. A simulation is therefore an operational model that allows participants to view a certain system rather than just certain aspects thereof (Le Roux & Steyn 2007). A simulation offers incredible learning opportunities by engaging participants in a unique learning from experience approach. Attention must however be paid to the many factors that can influence the effectiveness of simulations.

Simulations can enhance learning and may be employed by a diverse audience, including those from organisational, teaching and learning, and research backgrounds. This paper therefore sets out to familiarise the reader on the potential of utilising simulations, whether it be for academic or organisational purposes. The paper commences by elaborating on the learning from experience approach found in simulations, as well as the appropriateness for use in complex and uncertain situations. This is followed by a section, which deals with the benefits of using simulations. The focus then shifts to the various settings in which simulations can be used. This subsequently leads into concerns around designing simulations, and the conducting thereof. A brief conclusion is then presented.

Experiential Learning and Complexity

Simulations offer a significantly different and powerful route to learning by immersing participants in a safe environment where they learn from experience. Lane (1995) draws upon Kolb's model of experiential learning to explain how this occurs. This comprises of participants having concrete experiences, which leads them to observe and reflect on the experience, thereby promoting the development of abstract concepts that should then be applied and tested.

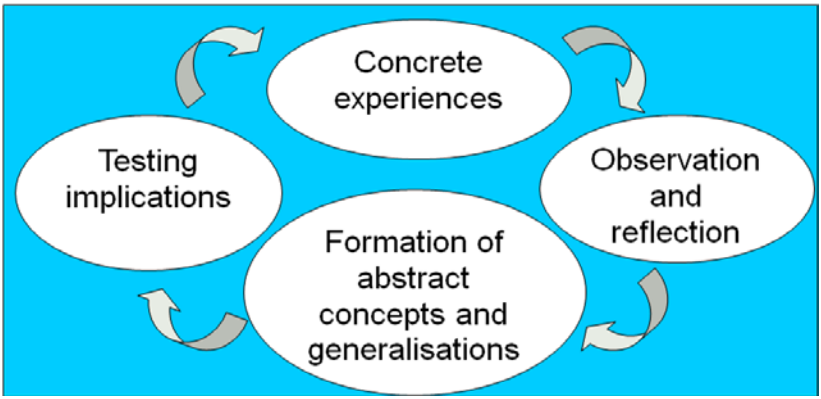

Figure 1: Experiential learning cycle (Kolb 1984 in Enciso 2001: 10)

The experiential learning method presents a way of captivating the attention of those involved. It engages the mental faculties, resulting in participants actively digesting information through involvement in a learning environment (Feinstein, Mann & Corsun 2002). Through the experiential perspective, participants work through an actual and complex problem by learning through various stages (Geurts, Duke & Vermeulen 2007). This then means that simulations are also appropriate for use in complex and uncertain situations. This is pertinent in situations where precedent means very little, and can assist in diagnosis and decision-making in uncertain conditions (Geurts *et al.* 2007; Dooley 2002). Self-organisation in a simulation occurs when behaviour emerges from the actions of various entities; important to note is that no one controls this and that the emergent behaviour has its own rules and laws (Dooley 2002). This feature is particularly potent in offering an alternative to traditional educational approaches, whether it is in a tertiary institution or organisational setting.

Participants can better comprehend complex systems, thereby allowing for the acquisition of systemic skills (Enciso 2001). Enhancing such skills can benefit learners and impact positively on various spheres of their lives. Simulations can also challenge common misperceptions that people have concerning what they think they know for certain, to rather discover emerging possibilities from specific actions (Leigh 2004).

Benefits of Using Simulations

Reframing Mental Models

Simulations offer powerful cognitive learning, which have far reaching consequences that tap into mental models (Dentico 1999). An effective simulation therefore portrays shared mental models and produces holistic communication (Keys, Fulmer & Stumpf 1996). The sort of learning where people engage in processes of interpretation is encouraged, in order for people to understand each other's thoughts and decision-making to consequently react effectively (Fannon 2003).

Double-loop Learning

People can be encouraged to do things differently, through the double-loop learning from the various roles, rules and behaviours found in simulation (Serrano *et al.* 2006). This deeper learning is achieved when the existing ways of thinking about how we go about things are challenged (Enciso 2001). Future behaviour is affected as participants become more cognisant. Simulations also incorporate cognition and emotion resulting in active learning to facilitate with dynamic and complex situations (Enciso 2001). The emotional aspects of the learner are thus acknowledged and embraced to enhance the learning experience.

Organisational Learning

Simulations can be particularly beneficial for organisations. Wenzler and Chartier (1999) argue that simulations are crucial to organisational learning, where the focus is on an organisation's ability to continuously learn and adapt to changes, rather than on attempting to forecast the future. Organisations can use this as an opportunity to approach change management from a very different angle that could have long-term benefits. Simulations provide an opportunity for reflection, experimentation, and action, and are useful in facilitating learning within the organisation (Keys *et al.* 1996). Furthermore, the outlook and behaviours of participants can change through their involvement in the simulation (Keys *et al.* 1996). It is important to note though that this is achieved in an unforced and natural manner, as opposed to the method often found in most traditional educational approaches.

Simulations also play a role in strengthening relationships between organisational members. Independent exploration is promoted (Adobor & Daneshfar 2006) but Pivec, Dziabenko and Schinnerl (2003) also point to a community of learning, which occurs through participants communicating their ideas, problems and solutions to each other. This joint learning is key to organisational effectiveness.

Problem-solving

It is useful to present people with a full view of how things work, but this is however not easily accomplished. Simulations can illustrate 'the totality of a model and the dynamics of a system' and prove critical in showing participants a holistic view of a problem (Geurts *et al.* 2007: 544). This is important in having them contribute towards solving the problem, and in so doing become accountable. Simulations allow participants to be introduced to the situation and problem, and they are encouraged to work towards solving it; thus, content is self-discovered (Lane 1995). Another important aspect is that participants may discover new features to a problem, as well as idea generation that can be considered by others (Geurts *et al.* 2007). Simulations can thus elicit creativity and increase respect and initiative amongst participants. Simulations can also unearth how people naturally deal with problems and relate to others in the real world (Stumpf, Watson & Rustogi 1994). This can assist participants in directing future behaviour.

Simulations provide a 'rich' experience due to the complex types of knowledge and the mixture of human reactions, emotions and interactions involved (Lane 1995). The richness also originates from the variety of issues involved, and it is this that allows for the creation of a new world emerging during the simulation (Stumpf *et al.* 1994). This includes participants choosing to investigate certain issues, who will be responsible for making choices, power distribution, climate and actions. A simulation can therefore be used to deal with an array of issues, which people may not even have been aware of. It is also more efficient to discuss all the issues concurrently, and while still fresh in the minds of the participants.

It is often difficult to analyse events, which are not in real time. During the rounds in a simulation, ordinarily slow processes are sped up and vice versa (Jackson 2004). Participants can therefore see the outcomes of a

decision in minimal time. The time pressure can also reveal a great deal to participants. Time constraints and uncertainties can affect the manner in which participants' access and share information, and contributes to bounded rationality (Stumpf *et al.* 1994). Simulation can help participants understand how processes are influenced by limited information and resources in reality. In the process, participants can develop critical skills such as decision-making and negotiation (Pivec *et al.* 2003) in the safety of the simulation where there are no serious consequences (Fannon 2003). Participants can therefore unreservedly become more adept.

Communication and Participation

Simulations can be used to engage various individuals in meaningful processes of communication and participation. It can be used to facilitate communication in complex situations with various groups in discussing ideas and closing communication gaps (Geurts *et al.* 2007). This is useful in almost any context. Barreteau, Le Page and Perez (2007) contend that simulations permit for legitimate and candid articulation from all stakeholders by promoting communication, positive dialogue, clarity and training in a complex system. Furthermore, if various participants from different organisational levels and backgrounds, as well as top management, are involved in the simulation, organisational learning can be great (Keys *et al.* 1996). Simulations can thus be used to negotiate through difficult situations involving people from various backgrounds who may have conflicting views. Simulations can also assist organisational members to see how their own role and that of others fits into the big picture. Simulations thus strengthen ties between those dealing with common resources and ensure future exchange among participants (Barreteau *et al.* 2007).

Testing

A problem faced by many organisations is that they often rush into implementation without consideration for a variety of factors. Simulations can aid an organisation confronted with significant change requirements in that strategy and implementation can be practised in a risk-free environment (Keys *et al.* 1996). Enciso (2001) also points out that testing can repeated as

many times as possible. This allows the organisation to be proactive and take corrective action before implementation of the change. Furthermore, participants can assess whether their skills are indeed adequate to embrace the new changes.

Settings for Simulation Use

Before proceeding into the different contexts where simulations can be used, it is useful to point out that most simulations can be computer-based or interactive. Computer-based simulations essentially use mathematics or object representations to imitate characteristics of a system (Feinstein *et al.* 2002). A problem with such simulations however, is that interpersonal learning and human processes cannot be effectively represented (Feinstein *et al.* 2002; Dentico 1999).

Simulations that do not utilise computers are interpersonal and focus on behavioural learning, with the aim of achieving agreement amongst stakeholders by experimenting and validating requirements for information and coordination (Keys & Wolfe 1990; Dentico 1999). It is suggested that the intended learning outcomes dictate the chosen simulation method (Feinstein *et al.* 2002).

Educational

It has been found that games are often preferred over conventional exercises (Pannese & Carlesi 2007). An example is that of case studies. Case studies are frequently used to assist learners but, as Fripp (1994) argues, fail in providing participants with a chance to experience the outcomes of their choices. Another problem is that case studies lead to single loop learning, whereas simulations offer double loop learning (Dentico 1999). Single-loop learning often results in short-term benefits and will probably be less effective. Simulations can therefore provide a fresh perspective to usual learning activities.

Simulation methods have been employed in many educational settings, both for under-graduate and post-graduate purposes and for a variety of subjects. Some of these include knowledge management, entrepreneurial learning and strategic management (Chua 2005; Pittaway &

Cope 2007; Zantow, Knowlton & Sharp 2005). Emphasis is placed on highlighting the importance of acquiring practical experience to either solidify concepts or to develop professional skills necessary for students to enter into future careers. This could be a way of addressing a common criticism that tertiary institutions often produce graduates who are ill-prepared for the world of work.

Organisational

Much emphasis is often placed on finding ways of engaging adults in learning processes. The use of simulations in a business context can therefore be particularly useful in this regard. Simulations have been used for learning in areas such as, agriculture, landscape dynamics, natural resources management, strategic management, and policy development (Dionnet *et al.* 2008; Depigny & Michelin 2007; Barreteau *et al.* 2007; Zantow *et al.* 2005; Geurts *et al.* 2007). Simulations are powerful tools of teaching (Jackson 2004) and are ideal for adult employees in organisations (Green 2002; Pivec *et al.* 2003). Business games model a whole or partial organisation, so that participants are able to see the connections (Pivec *et al.* 2003). This can enable individuals in various departments to better comprehend the organisation. There are also benefits in engaging learners in environments where they experience similarities to that at work (Feinstein *et al.* 2002). This is most likely to get their attention.

The active component of simulation as opposed to many approaches, which involve mere listening, appeals to executives and an array of problems can be dealt with in minimal time, thereby accelerating learning (Fripp 1994). Simulations therefore encompass the utilisation and not only the knowledge of facts and ideas, which entails a move from passive to active learning (Jackson 2004). This is critical in understanding why isolated training and/or education programmes may be insufficient. Simulations allow participants to produce new knowledge by interpreting their decisions and actions (Enciso 2001). This is a way for participants to become involved and responsible in their own learning.

A few examples of simulations utilised in organisational settings, as presented by Lane (1995) are briefly presented. Fish Banks is a game that teaches sustainable management in the fishing industry by allowing

participants to experience the benefits of initial success, which is later followed by the sudden depletion of the resource. The Beer Distribution Game aims to illustrate the dynamic behaviour of systems by allowing participants to be in charge of an integrated beer production, distribution, wholesaling and retail organisation. People Express Airline is focused on the factors that limit growth in organisations and aims to encourage long-term strategic thinking. These examples therefore illustrate the powerful learning outcomes that can be imparted through participation in a simulation.

Research

Simulations can also be used to aid in research. This is useful in theory testing and building (Dooley 2002). Simulation is thus seen as a different approach to conducting scientific studies, and can be viewed as 'a third way of doing science' (Axelrod 1997: 5). Simulations are ideal due to the observations that can be made in the setting, which then allows for the discovery of theoretically pertinent behaviour and outcomes (Feld 1997). Simulations also permit for observations into the future, unlike most research methods which examine the past (Dooley 2002). Researchers can thus engage in very stimulating studies. An appeal by Keys and Wolfe (1990) specifically calls for research into management gaming.

Designing Simulations

There are many notable existing simulations which can be utilised. The following points can however provide guidance in designing a simulation, if there is a need to construct a specialised simulation.

Collaboration in the Design Phase

There are many benefits in involving various individuals in the design phase. Firstly, it is useful to interview internal and external stakeholders to determine problem boundaries (Geurts *et al.* 2007). Furthermore, stakeholders will be in a better position to comprehend models and improve their knowledge by participating in the simulation with the result that a variety of opinions can be expressed (Barreteau *et al.* 2007). It is also important in that the models actually end up being examined, due to having

those who actually do the work, be involved in the simulation (Savolainen 1997). Such feedback can be used for the evaluation of the simulation. Another benefit is that participants will respond more readily to learning, when they feel that those at the top are involved and support the simulation (Green 2002).

Problem Identification and Illustration

The importance of consulting relevant literature is emphasised. Chua (2005) argues that not only should games be based on a sound, methodologically and empirically tested conceptual model, but also that applicable literature must be consulted. Reviewing the literature thus allows for identification of related models and concepts so that critical issues and events can be included in the simulation (Geurts *et al.* 2007; Chua 2005).

The problem should then be identified and its causes and characteristics be determined, and subsequent to that is the simplification and effective representation of critical elements (Leigh 2004). A model therefore is a simplified representation of the real world. It is necessary to simplify aspects in order to grasp the basics (Axelrod 1997); thus, the focus is not on exact duplication (Feinstein *et al.* 2002). This leads to the notion of verisimilitude, which is extremely important in simulations. Verisimilitude refers to the activities in the simulation being similar to those in the real world, so that participants can carry over experiential lessons to the real world (Lane 1995). This therefore means that participants are able to make critical connections to their reality.

Simulations also need to display outward simplicity, while still encompassing inner complexity, in order for participants to better understand issues by focusing on the achievement of a few goals (Borodzicz 2004). Research from Adobor and Daneshfar's (2006) study clearly indicates a link between individual learning, and that of the realism and user-friendliness of the simulation. It is recommended that a balance exists between simplification needed to grasp processes and realism to link this to reality, as this ensures that participants feel confident yet free (Barreteau *et al.* 2007).

Learners

Learners, and precisely what they should learn needs to be determined

(Leigh 2004; Pivec *et al.* 2003). This would entail taking into account the individuality of those involved. Green (2002) warns of simulations failing unless the significance of comprehending what intensifies the learning experience is identified. Furthermore, what learners need to do and the materials that they require must be considered (Leigh 2004).

Conducting Simulations

Simulations essentially consist of three set sequences: briefing, the action and debriefing, as well as further interrelated elements composed of rules which govern actions, specific roles and the relevant situations, and any physical records (Leigh 2004).

Briefing

This phase run by the facilitator is usually not as lengthy as the rest, and essentially involves captivating the interest of participants (Leigh 2004). It may be necessary to highlight the learning objectives of the simulation (Adobor & Daneshfar 2006) as well as the rules and requirements (Chua 2005). This phase although brief, is nonetheless important in ensuring that the simulation proceeds well.

Chua (2005) also advises administrators to incorporate aspects of theory, practice and assurance in the briefing. Furthermore, the intention of the simulation can be explained and this can be an opportunity to ease any fears by perhaps having a question and answer session (Chua 2005). It may be useful to point out that participants can note actions and behaviours, which can be discussed later. This will be useful during the debriefing phase.

Roles Assumed

Barreteau *et al.* (2007) draw attention to roles being formed by simulating certain features of people in the real world. This is influenced by access to resources, personal assets and goals, environmental factors, and behaviours. Players are assigned these simulated roles which may, or may not be similar to their reality, as is the case of those who play opposite roles. It is thus important that designers and facilitators bear this in mind.

During the actual simulation, participants construct their experiences, play their roles and meet set goals, whereas the facilitator steps aside to observe, and may circulate necessary information (Leigh 2004). The facilitator should therefore not interfere but should rather allow the simulation to unfold naturally. It is important that participants play various roles so they can acquire knowledge, practical experience and soft skills (Pivec *et al.* 2003). Participants must discover for themselves what it feels like to be in a specific role, along with the accompanying choices and outcomes (Chua 2005). This could be specifically pertinent in having participants better understand each other's jobs, and the relation thereof to their own.

Participants should be kept engaged, and scenarios can be modified to create fresh experiences for people who have played before (Chua 2005). New unanticipated events to facilitate learning should be introduced (Pivec *et al.* 2003; Borodzicz 2004). A further purpose of playing roles is to ensure that those involved remember that they are participating in a game where they can build the future by drawing on their creativity (Geurts *et al.* 2007). This could therefore lead to the emergence of valuable ideas which could be used.

Level of Challenge in the Simulation

Goals with an adequate challenge level need to be set; the simulation should not be too difficult or easy, as it is important to keep participants' attention (Pivec *et al.* 2003; Chua 2005). It may be useful to have trial runs before the simulation in the case of a game that is difficult to understand (Green 2002). Other benefits of running a trial are to identify any problems and also to become acquainted with the game (Fannon 2003).

The People in the Simulation

It is important to note the influence of group dynamics. Consideration should be given to the mix of people, for example, as Green (2002) points out, having participants together who are familiar with each other could result in groupthink, whereas having different people with their own personalities could create other problems. Issues of social structure between

management and employees may also affect the game negatively and it is important to remember the emotional elements of the game (Bordozicz 2004).

Care must be taken as to how teams are formed. Instructors should decide whether to allocate participants to teams or allow them to self-assemble rather (Adobor & Daneshfar 2006). It is recommended that one bears in mind the purpose of bringing together people and how precisely they are organised (Green 2002). Participants should also be encouraged to engage in constructive debate and dialogue rather than having personal conflicts with other participants (Adobor & Daneshfar 2006). This would be critical in the case of a group that already has existing conflict. Simulations must however not avoid constructive criticism for the sake of keeping peace, as this could result in group-think (Geurts *et al.* 2007). Cohesion building exercises prior to the simulation could assist, as well as the existence of a culture that encourages trust and respect for all people (Green 2002).

Facilitating the Simulation

Keys and Wolfe (1990) argue that the administration of a game is nearly as critical as the quality. Instructors should therefore not only focus on learning but also on factors around learning, like group dynamics (as mentioned previously) and features of the simulation (Adobor & Daneshfar 2006).

Much attention should be placed on preparation. Barreteau *et al.* (2007) caution those in charge of simulations to consider their choice of participants, medium, location, time, as well as illuminating their motives for raising awareness and their role in the process. It is recommended that every aspect, including the rules, confines, and feedback and anticipated commitment levels, of the simulation be made clear (Chua 2005). Leigh (2004) however cautions against facilitators inflicting their own views on participants, as players have to experience the consequences of their own decisions (Pivec *et al.* 2003). This again relates to the facilitator or administrator allowing for the simulation to proceed at its own pace.

The use of simulation essentially centres on facilitators embracing flexibility and releasing excessive command (Le Roux & Steyn 2007). It is important for designers and facilitators to bear in mind that there will be uncontrolled aspects due to the unique experiences and requirements of

participants, but that there will be order despite the appearance of disorder (Leigh 2004). This is in line with the acknowledgement of complexity.

Debriefing

This final phase of the simulation bears the most significance. This is where collective learning and discussions about reality occur (Barreteau *et al.* 2007). The following processes could increase the effectiveness of the debriefing phase. Borodzicz (2004) recommends overviewing the purpose of the game during the debriefing. Debriefing can also touch on positive and negative emotions experienced by participants, and to disengage from the roles (Fannon 2003). Participants can reflect on what they learnt with assistance from the facilitator, and this can be used to decide how to transfer the knowledge to the real world (Green 2002). The facilitator should therefore have been perceptive to occurrences in the simulation, in order to assist participants to reflect and learn.

Chua (2005) explains further advantages of the debriefing phase of the game. Participants can describe their experiences in the simulation to commence discussion. This can open up their emotions to acknowledge the affective component in learning and also encourage trust amongst participants. They can also raise any expectations that they had which were not consistent with the game, so that they can gather new insights (Chua 2005). Facilitators can use such information to assist with future simulations. Pivec *et al.* (2003) argue that participants learn not only by making mistakes but also through the consequent feedback. Learning opportunities that arise from the debriefing should be maximised.

Conclusion

Simulations are ideal in augmenting the learning experiences of students, as well as for addressing a multitude of complex situations faced in organisational settings. Simulations can be thus be used as an alternative to traditional learning approaches which often focus on passive listening. Researchers can also employ simulation as a powerful methodology. Through experiential learning, participants explore a problem and experience for themselves the outcomes of choices that they made. Benefits

of using this method include the opportunity for the exploration of mental models in order to acknowledge stakeholders' varying perspectives. Processes of communication and participation can be better handled, and participants can also test strategies in the simulation before implementation in the real world. On a practical level, it is advised that consideration be given to the many aspects of designing simulations. These include involving participants in the design phase to determine the problems, and how best to represent pertinent issues in a model. Aspects pertaining to learners and their needs, as well as to the designers and facilitators must be taken into account. Attention must also be dedicated to comprehending the different phases of simulations. It is hoped that this paper has illustrated the suitability of simulations for use in a variety of settings and presented a useful framework to navigate through.

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