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A thesis submitted in fulfilment of the requirements of the degree of
Doctor of Philosophy in the Centre for Learning Innovation,
Queensland University of Technology

February 2007
Keywords

Activity theory, blended learning, immersive virtual reality, authentic learning environment, constructivist learning style, situated cognition, cognitive apprenticeship, technology education, business education, university teaching, ICT.

Short Abstract

New advances in computer programming and more powerful technology have opened up new opportunities for learning though immersive virtual reality simulations. This research highlighted the importance of the role of a lecturer in fostering learning in a technology rich learning environment. Undergraduate business studies students worked collectively to try resolve a problem depicted through an immersive simulation involving a burning factory. The simulation provided a rich personal experience that enabled students with lecturer support to generate effective strategies to address the problem.
Abstract

Considerable research has explored the proposition that Information and Communication Technology (ICT) tools can facilitate in creating authentic learning environments, thus improving student learning, interaction and satisfaction. Previous research has focused on using various forms of ICT such as online learning and web-based learning in the classroom. New advances in programming and more powerful technology have opened up new opportunities over the past decade, not least in virtual reality simulations. However, limited research has investigated the effectiveness of incorporating immersive virtual reality technology into the university classroom. The research reported in this thesis explores the implementation of immersive virtual reality in a university course focusing on business studies. In particular the study investigated three questions: Firstly, how do participants interact with the components of a VR learning environment situated within the context of a business studies unit that focuses on the development of decision-making skills in crisis events, secondly, what relationships exist between virtual reality learning environment and other components of a unit of study that focuses on the development of decision-making skills in crisis events, and finally, what theoretical conclusions can be drawn on the effectiveness of virtual reality scenarios in similar contexts where VR learning environments are blended with other teaching/learning approaches.

The study was situated in an undergraduate Bachelor of Business course at a large metropolitan university in Australia. Participants of this research were first and second year business degree students studying a unit on “decision making” which extended over 13 weeks of a semester. Teaching approaches involved a number of initiatives designed to enhance learning and provide an authentic learning environment. Data were collected over thirteen weeks (one semester). Data sources included artefacts, focus groups, classroom and virtual reality theatre observations and formal and informal interviews of participants. Among the initiatives was a virtual reality scenario depicting a factory that had experienced a manufacturing breakdown. The study analysed the interactions that occurred during this session in which students attempted to devise strategies to cope with the factory breakdown. Using activity theory as the
framework for data analysis, the study further investigated the way the virtual reality session was integrated into the unit.

Conclusions in relation to interactions among participants during the VR session (Research Question 1) indicated that a VR environment fostered active engagement in problem solving. Students worked collectively to try to find information about what was happening and reached a conclusion to the problem posed. Students applied strategies learnt in previous sessions to solve the problem. However, the findings emphasise the seminal role of the facilitator and the authenticity provided by the VR software. The facilitator adopted instructional practices to engage students in using the affordances of the VR software. During the session, students were in particular capitalising on the authenticity provided by the simulation. VR performed as a key tool to establish this authenticity. However, the expert role of the facilitator was pivotal.

Conclusions drawn from an analysis of the dynamic interrelationships among the sub-systems (Research Question 2) revealed that there was lack of interconnection between the sub-systems or various teaching events. Because of this lack of integration, the VR environment was not utilised to its fullest potential. It was observed that the VR environment was seen as an add-on sub-system. Failure on the part of the teacher to acknowledge and capitalise on the VR experience meant that the experience was not viewed as integral to the unit by both students and teacher and not valued as a worthwhile activity.

Further analysis of the data led to the postulation of six theoretical principles to inform the implementation of VR in teaching in higher education. In outline, these principles are addressed: technical qualities of the VR Software, emotive engagement, promotion of interactivity, curriculum alignment, assessment, blending of learning experiences.

Implications are drawn for future research and practice in higher education.
Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature……………………………………………………………………………….

Date…………………………………………………………………………………..
Acknowledgments

To my wonderful supervisors, Assoc. Prof. Jim Watters and Assoc. Prof. Rod Nason, thank you for your guidance.

To Khalid, Sarah, Ariff and Amar, thank you for your undivided love and support.

Untuk Mak tersayang, ini hadiah untuk Mak.
Awards and papers

1) Exemplary use of ICT Award.

The Australasian Society for Computers in Learning in Tertiary Education Conference (ASCILITE), December 4-7, 2005 Brisbane, Australia. (ASCILITE Award for exemplary use of ICT in Teaching and Learning at Tertiary Level).


2) Outstanding Paper Award.

The 17th World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA), June 26-30, 2005, Montreal, Canada.

Publications


Conferences (Fully reviewed)


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<tr>
<td>BCG</td>
<td>Boston Consulting Group</td>
</tr>
<tr>
<td>CPU</td>
<td>Central Processing Unit</td>
</tr>
<tr>
<td>GVR</td>
<td>Group Virtual Reality</td>
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<tr>
<td>HMD</td>
<td>Head-mounted display</td>
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<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>JRM</td>
<td>Jonassen and Rohrer-Murphy</td>
</tr>
<tr>
<td>MOPP</td>
<td>Manual of Policies and Procedures</td>
</tr>
<tr>
<td>OLT</td>
<td>Online Learning and Teaching</td>
</tr>
<tr>
<td>QMI</td>
<td>Queensland Manufacturing Industries</td>
</tr>
<tr>
<td>VLE</td>
<td>Virtual Learning Environment</td>
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<td>VGFC</td>
<td>Virtual Golden Foods Corporation</td>
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<td>VR</td>
<td>Virtual Reality</td>
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<td>VRML</td>
<td>Virtual Reality Modelling Language</td>
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<tr>
<td>TAFE</td>
<td>Technical and Further Education</td>
</tr>
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<td>ZPD</td>
<td>Zone of Proximal Development</td>
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Chapter 1: INTRODUCTION

‘Wisdom is not a product of schooling but of the lifelong attempt to acquire it.’
-Albert Einstein

1.1 Background of Study

The fast-paced, technology savvy business world today has forced universities to modify their current business curriculum to ensure that their graduates meet the ever changing demands of the industry. Business graduates today are exposed to various different challenges and skill requirements. If they are not prepared, they will not survive the working world. Key writers maintain graduates need to be encouraged to develop adaptive decision strategies which prepare them effectively for the complex business world (Harrison, 1999; Payne, Bettman, & Johnson, 1993). Employers lament the quality of graduates in such areas as communication (Gustafson, Johnson, & Hovey, 1993) and decision-making (Mariani, 1994).

The responsibility to prepare graduates who can meet the challenges of leading today’s sophisticated and competitive industries lies with the quality of the learning environment that students experience. The quality of teaching at business schools is criticised when their graduates fail to deal with real world problems (Radhakrishnan, Crino, Davis, & Camlibel, 2005).

Many researchers, particularly in the business field, have realised the importance of keeping abreast with the latest changes in the business world. With the advent of technology, it is vital for faculty members to be prepared to accept and practice change; not only on the use of technology, but also in the updating of undergraduate curriculum for business studies in ways that accommodate the affordances provided by technology. Strategies that reflect
workplace learning at universities today are important to prepare undergraduates to face the real world. This disposition is important because the product of Business Faculties nation-wide reflects the quality of teaching and learning, especially in the area of decision-making available at a particular University. One of the major problems with university faculties is lack of conscious attempt to incorporate the real world problems in their lectures (Richter, 1999).

The fall of multinational firms like Enron, Arthur Andersen, and Worldcom a few years ago is an example of ineffective decision-making on the part of business executives (Nill, Schibrowsky, & Peltier, 2004). Nill et al. (2004) argue that in many cases, the executives themselves lacked the skills to access information in a technologically rich environment and operated in ways that do not meet modern demands. At present, business students are exposed to approaches to learning about decision-making through printed-based case studies. Case studies are the normal instructional approach where students are expected to visualise the real situation and they are expected to reach quality decisions based on individual visualisation capabilities.

For these reasons, the researcher argues it is time for students to be exposed to more authentic learning environments using 3D simulations that are now readily available. A form of 3D simulation, virtual reality technology, is a state-of-the-art technology-rich educational tool that allows learners to visualise the case studies and facilitate their experiences in situations that they have never seen or experienced before. Technology-rich simulated environments are effective to teach workplace learning.

Furthermore, from years of tertiary level teaching experience, the researcher feels that there is an urgent need for a technology-facilitated change in instructional practices in order to produce business graduates who are competent in making decisions in a crisis situation. Preliminary investigations have also shown that, as the availability of technology-rich learning
environments become cheaper, adaptation to technology in learning decision-making is ever more critical.

This thesis explores how a technology-rich learning environment facilitates university students’ learning of decision-making in a business study context. This chapter begins by elaborating a business studies program. It then proceeds to preview issues around learning with technology, defines the scope of this research, outlines the aims and the specific research questions, argues the significance of the study, profiles the scope and finally presents an overview of the thesis.

1.1.1 Business Studies

Business education is facing significant problems in fostering learning in marketing decision-making skills to meet emerging demands of the industry (Perreault & McCarthy, 2002). The current practice in learning decision-making uses print-based case studies. Students are required to make decisions about complex situations based on such case studies. Exposure to print-based case studies alone does not provide enough stimuli to represent a real world scenario, rather their interpretation of the case studies varies and this causes difficulty for the students in a classroom to absorb and comprehend, and further make decisions and solve the problems given in the cases studies.

Decision-making skills have become even more complicated when marketing managers often have to balance their responsibility to meet the profit goal of the organisation they are working for with the legitimate interests of other stakeholders (Lund, 2000). The business community is challenging the universities to develop better ways of teaching decision-making skills to business students (Nill & Schulz, 1997; Schibrowsky & Peltier, 1995). Thus, the process of learning decision-making in a crisis situation should be continuously developed so learners are able to make better decisions. Some
critical aspects of designing good case studies in the classroom are how well they engage the learner, are interactive and represent the real world (e.g., Herreid, 1997). Furthermore, many researchers and business scholars have argued that marketing decision-making may involve several issues including unethical decisions on the part of the marketing executives (Nill et al., 2004). Thus, technology can be used to enhance learning decision-making (Farhoomand & Drury, 2002; Kang, 1994).

1.1.2 Learning with Technology

Educational technology has evolved since the early 1950s (Jonassen, Howland, Moore & Marra, 2003). Twenty years ago the presence of computers in classrooms was rare. Progressively, computers have become cheaper, smaller and more powerful. This trend has opened up further avenues for educational applications. By the turn of the century, research had revealed that in order for learning to be most effective, the emphasis should be on learning with technology instead of learning from technology. Technology should be considered as a tool in learning and as such, it is important to know how technology can be manipulated to aid learning.

The question is not whether Information and Communication Technologies (ICT) belong in classrooms, but how they can be most effectively used and how learning organisations can ensure that investment in the technology results in worthwhile learning outcomes for all students (Pea, 1985). In technology-rich environments there are many issues that impact on the effectiveness of learning. For example, access to the technology, motivation towards technology, pedagogical practices and the extent to which technology can add value to the curriculum are all factors that need to be considered.

A number of studies have shown that technology-rich environments greatly enhance learning for many learners who otherwise find learning difficult in traditional classrooms (for example, Daiute, 1992; Sutherland, 1995; Vincent,
Individual differences among learners and the learning environment can affect learning (Schunk, 2000). One aspect of individual differences is the different cognitive styles adopted by the learner in the learning process. Cognitive style refers to the unique way of thinking and reasoning that characterises an individual learner. Vincent (2003) argues that technology-rich environment can cater for all cognitive style differences in a classroom simultaneously.

In a technology-rich environment, learners’ attention is secured through the sophisticated characteristics of the technology itself. A technology-rich environment has the ability to motivate learners and learning by providing settings different from the normal classroom (Jonassen, 2000; Pea, 1985). Driscoll (2000) suggests presenting some materials through different media, including alternating lecture with live demonstration. Keller (1984) proposed four conditions that must be met for a learner to be motivated to learn: attention, relevance, confidence, and satisfaction. These conditions, when integrated, with ICT-based learning environment, provide opportunities for learners to engage effectively. The main point in Keller’s (1984) argument is that learners’ attention must be maintained because once a learner’s attention is lost, motivation is lost, and learning does not occur.

Despite the benefits provided by technology-rich environments, the effectiveness of technology is still unresolved with key researchers such as Cuban (1986, 2001) remaining highly sceptical of the outcomes of technology on students’ achievement in American schools. He argues that computer skills can be acquired outside of schools such as through part-time jobs or at home. He also argues that limited access to technology, especially schools in remote areas, hinder the success of technology in schools. However, he suggests more research be done to determine whether technology can help in areas such as intellectual development. As with any educational innovation, teacher’s beliefs and dispositions toward change influence the extent to which they might engage with technological innovation (Mumtaz, 2000).
1.2 Scope of this Research

This study explored student learning in a naturalistic setting of a classroom in which students as part of their undergraduate course in business studies were studying decision-making skills. In this context, the notion of learning environment is important. The following sections provide definitions of core terms relating to the study and elaborate on the key issues of relevance to the scope of this research. Firstly, a brief description of what is virtual reality, followed by a brief explanation on what constitutes an authentic learning environment and, finally, how technology can construct virtual reality learning environments.

1.2.1 Virtual Reality and Virtual Reality Modelling Language

The rapid emergence of three-dimensional (3D) virtual technology has brought about tremendous changes in the world. Applications in the fields of entertainment, architecture, manufacturing, art, medical, education and training have seen the effectiveness of this medium. The flexibility, reliability and adaptability of this environment are very much sought after, especially in education and training.

Virtual reality (VR) is a term coined by Jarod Lanier, a computer programmer in 1988 (Burdea & Coiffet, 2003). The term has been used to refer to “a combination of high-speed computers, advanced programming techniques, and interactive devices designed to make computer users feel they have stepped into another world, a world constructed of computer data” (Grady, 2003, p xi). VR can immerse people in an environment that would normally be unavailable due to cost, safety, or perception restrictions. A successful VR environment offers users immersion, navigation, and manipulation (Hamit, 1993; Heim, 1998). Burdea and Coiffet (2003) described virtual reality as a simulation in which computer graphics were used to create a realistic looking world that responded to user inputs.
Virtual Reality Modelling Language (VRML) is a powerful form of a computer language to construct the VR simulation. To view a VR simulation that has been developed using VRML, there are no special requirements for the hardware (Carey, Bell, & Marrin, 1997). It can be viewed over the web through a web explorer plug-in that functions to explain the VRML file and show the VR scene. This plug-in is called VRML player, an example would be Cosmo Player. Users can observe the virtual world from the computer monitor and control the moving objects and making decisions in the VR scene by using keyboard or mouse (Xianglong et al., 2001). The viewing of VR simulation via a VRML plug-in for Web browsers is usually done on a graphics monitor under mouse-control. Although popular in, for example gaming software, these approaches are not fully immersive and hence lack some elements of perceptual engagement of the user with the depicted environment.

The first device to be used for immersive experience was the head-mounted display (HMD). This device was introduced in 1965 (Heim, 1998). A motion tracker continuously measured the position and orientation of the wearer’s head and allowed the image generating computer to adjust the scene representation to the current view. As a result, the viewer could look around and perceptually engage by being able to walk through the surrounding virtual environment (Grady, 2003; Heim, 1998).

For the purpose of this research, Group Virtual Reality (GVR) was used. GVR uses semi-spherical screen, immersive display facilities that feature high-brightness, stereographic and non-stereographic projectors. There is no need to use the HMD since full immersion can be achieved through GVR. Figure 1.1 depicts the GVR in session. The curved screen contributed to the immersiveness in the theatre.
1.2.2 Learning Environments

Effective learning environments are typically constructivist in nature, engaging learners in meaning making or reasoning about the resources available in the surrounding environment. Wilson (1996) described a learning environment as “a place where people can draw upon resources to make sense out of things and construct meaningful solutions to problems” (p. 3). A typical learning environment includes an enabling context, complete resources, a set of tools, and scaffolds (Hannafin, Land, & Oliver, 1999). These components complement each other in providing an effective learning environment.

Jonassen and Land (1999) argue that effective learning environments require manipulation of space that provides learners a sufficient area to research, experiment, and pose hypotheses with the problem. Furthermore, technologies in the learning environment should be utilised to engage students in meaningful learning. Attributes to meaningful learning include keeping students active, constructive, collaborative, conversational, reflective, contextualised, complex
and intentional. These attributes interconnect with each other and the learners to achieve the learning goals.

Hence an effective learning environment is defined as a space or combination of spaces for studying that takes advantage of computer technology and integrates technology and other affordances into the learning process (Jonassen, 2000; Scott & Philips, 1998). In general, effective learning environments have two main functions. Firstly, they can help learners to use traditional and digital media in learning. Secondly, an effective learning environment provides information on the courses and studies (Sumner & Taylor, 1998) and thus connects the purpose for learning with career goals. It is argued that learning environments can be a significant source of advice and support learning during the studies (Sirkemaa, 2003).

Another important feature of effective learning environments is that they facilitate and capitalise on social learning. Ideas of cognitive apprenticeship are important in which the instructor takes a more facilitatory role. Students, as apprentices, are inducted into a community of expert in which the “teacher” continuously engages in and is a master of the practice being learned. Their performance constitutes the standard for the apprentice (Jarvelaa, 1995).

In this study, it is argued that VR produces learning environments that are authentic but virtual.

1.2.2.1 Authentic Learning Environment

The concept of authentic learning has been around for quite some time; however its application is subject to individual interpretation. This research focused on authentic learning environment with technology embedded tools such as online learning and VR technology.
Authentic learning environment is a term used to refer to a unique learning environment that consists of learning activities that contribute to effective learning (Herrington, Oliver & Reeves, 2003). Authentic learning environment requires authentic learning activities to achieve the learning goals. Activities associated with authentic learning environments are addressed in chapter 2.

The extent to which these can be achieved in a virtual environment is now addressed.

1.2.2.2 Virtual Learning Environments (VLE)

The term virtual learning environment has several different meanings. The traditional idea of VLE is in the form of simple electronic books used by teachers containing simple texts and graphics. There was no dynamic interactivity in this type of environment. As computing technology advanced, the capability to provide more sophisticated and dynamic applications for both CD-ROM and online environments increased. The design and development process saw the introduction of graphic designers who have made the environments visually more engaging. Learning technologists also helped to balance the influence of the programmers on the learning environment and bring the focus to the pedagogical issues (Clark & Maher, 2001).

Recent connotations of virtual environments are not restricted to just text and graphics, but can include sound, video, and animation, all possible on both CD-ROM and online. These virtual environments are populated with communities, who are able to interact and communicate with each other in many forms. They have the shapes, form, structures and functionality that are akin to the physical world (Maher, Clark, & Simoff, 2001). In such situations students have the opportunity to engage in argumentation, discussion of ideas and to have opportunities to justify their reasoning strategies. The establishment of virtual environments which engage students through VR is now possible.
1.2.2.3 Virtual Reality Learning Environment

A virtual reality learning environment is one of the more advanced types of virtual learning environments. Virtual reality describes everything from 3D animation on personal computers to networked simulators and it is associated with simulations (Jonassen et al., 2003). In the educational setting, VR can help students understand situations or phenomena that are difficult to understand with traditional instruction.

A VR learning environment allows its users to get immersed in the simulation, thus giving the sense of being part of the real world that it represents. In this study, the term VR was used and it specifically refers to VR that is not assisted by electronic devices such as head mounted devices, gloves or wands, but VR experienced through screen based 3D environments.

Dalgarno (2002) lists the following characteristics of a 3D environment:

- The environment is modelled using 3D vector geometry, meaning that objects are represented using x, y and z coordinates describing their shape and position in 3D space;
- The user’s view of the environment is rendered dynamically according to their current position in 3D space, that is, the user has the ability to move freely through the environment and their view is updated as they move;
- At least some of the objects within the environment respond to user action, for example, doors might open when approached and information may be displayed when an object is selected with a mouse; and
- Some environments include 3D audio, that is, audio that appears to be emitted from a source at a particular location within the environment. The volume of sound played from each speaker depends on the position and orientation of the user within the environment. (p. 3).
His model is represented in Figure 1.2.

Figure 1.2. Characteristics of VR learning environment.

Source: Adapted from Dalgarno (2002).

Wann and Mon-Williams, (1996), provide another view on VR learning environments. They argue that one of VR learning environment’s central components is the ability to interact by direct manipulation. A VR learning environment, therefore, has the potential to provide a powerful interactive simulation of three-dimensional structures in a virtual world. They also support natural aspects of human perception by extending virtual information in three spatial dimensions.

The characteristics of VR learning environments suggest that they provide a powerful authentic tool to support learning.
1.2.3 Virtual Reality as a Learning Tool

The benefits of learning through immersive VR environments have been well documented in the areas of cognition and spatial domains (Kalawsky 2004, Osberg, 1993; Psotka & Davidson, 1993). There is a limited body of research in the area of decision-making that has utilised VR. Among them, Macpherson and Keppell (1998) report of VR projects aimed at developing decision-making in archaeology and collaborative work. Similarly, significant for this study is the work of Xianglong et al. (2001), where VRML based VR simulation was used for developing sequential decision-making in a manufacturing environment. This research and project descriptions suggest that decision-making skills are targeted but these studies have not measured the degree to which these skills were acquired in the VR domain. More so, empirical studies as to the effectiveness of VR tools, particularly in crisis scenarios and stressful conditions are very limited.

Previous studies in integrated multimedia technology in education and training provide sound evidence of the benefits derived through the collaborative and problem-based nature of these environments (Dillenbourg & Traum, 1996). These promote activities of role-playing, collaborating and negotiating on solutions for scenario-based problems, applying the theory of constructivism paradigm where users construct their own reality and interpret it to create new knowledge. Fully immersive VR driven by devices mentioned earlier even take this further by removing the interface of the computer and virtually places the user within the computer and “human-generated” environments (Moore 1995; Youngblut, 1997).

Advances in computer technology have opened up many new and exciting forms of learning environments such as virtual learning environments (Byrne, 1993). This new form of learning environment is increasing in importance
because of the wide availability of computers, their effectiveness as a learning medium (Bowman, Hodges, Allison, & Wineman, 1999; Byrne, 1993; Pantelidis, 1993), wider range of students who have access to these tools (McLester, 2002), and reduced costs associated with learning (Bricken & Byrne, 1992; Wann & Mon-Williams, 1996).

Thus it has been argued that VR can provide that “transitional interface” between university learning and the workplace allowing the transformation of conceptual learning to experiential learning. It promotes learning that lasts by providing a simulated version of the real life and allowing manipulation that is not available in the normal classroom environment. Tangible and intangible aspects of a corporation can be simulated in this environment which is difficult to produce using other forms of technology.

### 1.3 Activity Theory – A Theoretical Framework

The context in which teaching and learning occur can be considered as an activity which can be analysed in terms of activity theory (Jonassen, Rohrer-Murphy, 1999). Activity theory which has evolved from the original conceptualisation of learning by Vygotsky (1978), Luria (1976) and Leont’ev (1947/1981) has been recognised for its ability to help understand and analyse the dynamic social interactions mediated by technology at both the micro level (psychological and interpersonal) and the macro level (sociological or cultural). A seminal contributor to the internationalisation of activity theory has been the Finnish researcher Engeström (1987).

Activity theory is concerned not only with the conceptualisation of the learning experience as an activity but also as a sequence of activities within the experience itself (Bodker, 1996; Kaptelinin, 1996). Leont’ev proposed that we can examine human processes from the perspective of three different levels of analysis. The highest, most general level is that of activity and motives that drive it. At the intermediate level are actions and their associated goals, and the
lowest level is the analysis of operations that serve as means for the achievement of the higher-order goals (Leont’ev, 1977). Thus it enables the researcher to understand the relationships among all learning experiences that go together to produce a unit of study. It provides insights into motives and actions of individuals and the influence of the context on that individual at different levels. Activity theory is increasingly being applied to technology-oriented research (Bodker, 1996; Nardi, 1996a). A key contributor to this field is the Swedish researcher Kaptelinin (1996, 2003) who has applied activity theory to the educational use of information technologies because it focuses not only on the technology but also on the psychological aspect of the activity. Table 1.1 shows the manifestation of activity theory’s principles according to Kaptelinin (1996) and its manifestation in this research.
Table 1.1
Principles of activity theory and its manifestation in this research

<table>
<thead>
<tr>
<th>Principles of activity theory, (Kaptelinin, 1996)</th>
<th>Manifestation in this research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity theory evaluates the identification of the psychological aspects of computer tools and how they vary from other types of artefacts.</td>
<td>The psychological nature of the decision-making process, especially when using the decision-making tools was evident in solving the case studies in the tutorials and in the VR exposure.</td>
</tr>
<tr>
<td>Activity theory evaluates the consideration of the activities, actions or operations because this can influence the design and training approach</td>
<td>The activities in this research involves being in a VR environment, a form of technology specifically used to provide simulation to the research study. It was designed to fit the learning process in this study.</td>
</tr>
<tr>
<td>Activity theory allows an analysis of the developmental aspects of learners from beginners to experts as new skills were developed with experience.</td>
<td>Analysis of learners in this research, from the beginning of the semester until the end of the semester reveals how activity and its surrounding helped shape their understanding learning decision-making theories.</td>
</tr>
<tr>
<td>Activity theory focuses on the importance of social influences on the use of computer tools which determines the success of the system.</td>
<td>The relationship with the VR environment as the major computer tools and cultural influences among the subjects is the focus of this research.</td>
</tr>
</tbody>
</table>

Note: Adapted from this research and Kaptelinin (1996).

From table 1.1, the adaptation of activity theory clearly identifies the appropriate aspects for this research. The focus on learners and their relationships with the other communities in the technology-rich environment complemented the activity theory approach.

1.4 Research Questions

The overall aim of this study is to investigate through the lenses provided by activity theory (Engeström, 1987, 2001; Kaptelinin (1996); Leont’ev, 1947/1981) how students’ interactions within a VR learning environment
situated in the context of a business studies unit influence the learning of decision-making skills in crisis events.

VR learning environments can be utilised alone or in conjunction with other teaching/learning approaches. Within this study, the VR learning environment was utilised in conjunction with other teaching/learning approaches such as lectures/tutorials, online discussion forum and an industry panel presentation. Each of these four teaching/learning events was identified as an activity system (Engeström, 2001).

The study had two broad foci: a within-activity system focus and a between-activity system focus. Firstly the research sought to investigate the influence of the VR learning environment on the learning marketing decision-making (i.e., within an activity system). Secondly, it sought to understand the interrelationships between the VR learning environment and the other three types of teaching/learning events (i.e., between activity systems). This dual foci is reflected in the three research questions listed below.

1. How do participants interact with the components of a VR learning environment situated within the context of a business studies unit that focuses on the development of decision-making skills in crisis events?

2. What relationships exist between virtual reality learning environment and other components of a unit of study that focuses on the development of decision-making skills in crisis events?

3. What theoretical conclusions can be drawn on the effectiveness of virtual reality scenarios in similar contexts where VR learning environments are blended with other teaching/learning approaches?
1.5 Significance of Study

With the rapid change in the business world today it is imperative for business graduates to have advanced decision-making skills to equip them. The normal practise of using print-based case studies in classrooms has limitations when it comes to providing a real world problem (Watson & Oliveira, 1998). Lack of resemblance to the real world, especially in crisis events will provide different interpretation of the same case thus it is difficult for the teacher to tailor the instructions to meet the objectives of the unit. Therefore, there is an urgent need to provide students with case studies that resemble the real world as close as possible so learning can be more effective. One option is the VR simulation that provides 3D visualisation. The simulation will not only bring the real world to the classroom, but also aid students in releasing the working memory of the brain from having to imagine the scenario and the crisis that is happening. This will in turn allow students to focus on the decision-making process, thus enhance their understanding.

The use of VR technology as a learning tool in learning decision-making in a crisis situation is seen as important and is expected to contribute immensely to the skills students have. Technology has been shown to provide students with endless opportunities to help them in the learning process. For this research, the case study was represented in a VR simulation where the sense of “being there” was experienced among students. The VR simulation was seen as a technology tool to enhance the process of learning decision-making.

Several factors enhance learning in an immersive environment. Among them are, the actual crises is impossible for training and difficult to get feedback. VR simulation allows for representation of actual crises, thus contributes to acute stress as experienced in a real world (Sniezek, Wilkins, & Wadlington, 2001).

It has been argued that there is great potential in using VR environment as part of interactive technology in the classroom (Bork, 1991). Thus this research
investigated learning in an authentic learning environment with VR technology embedded in it facilitates students’ understanding in learning the process of decision-making.

These problems prompted the researcher to focus on learning in the context of VR. Using VR in the special VR theatre allowed students to actively interact with the environment rather than passively receive knowledge from the teacher or textbook. Active decision-making in a simulated environment gave students the feeling of being part of the real action happening in the real world (Jonassen et al., 2003), which, in turn, helped increase understanding in the process of decision-making.

The availability of real-life situations considerably helped learners of decision-making to visualise the situation and thus learned effective skills of decision-making before becoming executives of real, multinational companies. Thus, the main significance of this study was the new knowledge about learning in a VR environment that was developed and how this new knowledge bridged the gap as mentioned in the literature review in chapter 2.

1.6 Context of the Study

The study was sited in a business studies faculty to capitalise on the experience of the researcher. The researcher has been teaching at large technology-based Universities both in Malaysia and in Australia for 15 years in the field of business and information technology education; hence the interest in the area.

This study was a semester-long study focusing on a small group of business students learning in a naturalistic classroom environment with VR environment embedded as part of the authentic learning environment. The students, their teacher and the facilitator were observed during lessons employing VR learning environment and the learning outcomes were recorded and analysed in order to
generate practical and theoretical frameworks that will guide the future design and application of VR environments in educational settings.

1.7 Overview of Thesis

This thesis has begun with the description of the background to this research, explanation of the business studies program and issues in learning with technology. Definitions of core terms were provided including the VR technology, and learning environments. Several components of an authentic learning environment specific to this study were explained, focusing on VR learning environment. The importance of the study is described before outlining the objectives. Chapter 2 will focus on the theories of learning in an authentic learning environment including the technology-enhanced environment. Literature review of past research in VR learning environment is explored in chapter 2. The purpose of this chapter is to develop a theoretical framework for the research. Chapter 3 will outline the methodology of the study where the conduct of the main study is explained further.

Chapters 4 and 5 explore results of the research through the lenses of activity theory. At the micro level, interactions within the VR environment were investigated, while at the macro level, the dynamics of interaction between the VR environment and the other teaching events were analysed. More specifically,

Jonassen and Rohrer-Murphy’s (1999) approach to activity theory was adapted to this study (further explored in chapter 3). Chapter 6 focuses on research question 3 and chapter 7 discusses the recommendations and conclusion for future research.
Chapter 2: LITERATURE REVIEW

‘You cannot teach a man anything. You can only help him to discover it within himself.’

- Galileo Galilei

2.1 Chapter Overview

The significance of this research was established in chapter 1. The study addresses important pedagogical issues relating to implementing technology supported authentic learning environments in the context of business studies. The study draws upon two broad theoretical bases that are analysed in this chapter. First, theories related to technology education, multimedia and VR learning environments will be explored. Second a discussion will be presented of the ways in which the cognitive and learning theories associated with multimedia learning interact.

The purpose of this chapter is to develop a theoretical framework to guide the research and to identify those variables and their relationships that might inform the analysis of data. There are eight main sections to this chapter. Section 2.1 is the introduction. Section 2.2 explores the literature relating to technology as a tool in learning. Section 2.3 focuses on the theories of learning with technology. Section 2.4 explores the roles of the learner from a constructivist view of learning. Section 2.5 explores the relationship between the constructivist view of learning and technology education. Within this section, various cognitive theories of multimedia learning are explored. Section 2.6 highlights the authentic ICT-based learning environment. The concept of blended learning is also examined in this section as the teaching included a range of strategies that capitalised on both technology and face-to-face experiences. Section 2.7 explores the unit content which is “marketing decision-making in a crisis situation”. Finally, in Section 2.8, the chapter concludes with a proposed theoretical framework and identification of the key research questions.
2.2 Technology as a Tool in Education

The development of the printing press in the 15th Century was a major technological advance that enabled the mass distribution of information through print and paved the way towards European Renaissance. Technology as a tool in supporting learning has continued to evolve. During this time, outlines and drawings of technological equipment appeared in books and chalkboards (Jonassen et al., 2003). During the twentieth century the impact of electronic and computing technology has been substantial. Research has supported the idea that technology has indeed promoted learning in various ways including knowledge construction, knowledge exploration, and as a medium to cultivate learning with others (Abbot, 2001; Jonassen, 1995). Practitioners and researchers have come to realise that it is not what equipment is used, but how the equipment is used which makes it relevant to the classroom (Strommen & Lincoln, 1992). Jonassen et al. (2003) pointed out that it is important to view technology as an aid that helps promote effective learning. They listed the following ways that technology can be used to engage and facilitate thinking and knowledge construction:

- Technology as a tool to support knowledge construction;
- Technology as an information vehicle for exploring knowledge to support learning by constructing;
- Technology as a context to support learning by doing;
- Technology as a social medium to support learning by conversing; and
- Technology as an intellectual partner to support learning by reflecting.

Technology has advanced rapidly and its use in the field of education has produced dramatic changes in how learners are able to learn, what they should learn, types of problem solving situations they should be able to address, and what stages of problem solving tend to be emphasised (Kelly & Lesh, 2000). Much of the research has tended to be in school-based educational situations or in select areas of higher education (Bricken, 1991; Bricken & Byrne, 1992; Dalgarno, 2004). As was argued in chapter 1, the application of technology in
other disciplinary areas, in higher education, is now commonplace. Thus, there is a need for research to focus on how technology has impacted on the learner in these new contexts.

2.2.1 Barriers and Affordances of Technology in Education

In discussing the use of technology, it is important to examine some of the barriers and affordances of technology in education. Ellington, Percival and Race (1993) argue that technology can lead to the overall efficiency of the teaching and learning process, for example by:

- Increasing the quality of learning;
- Decreasing the time taken for learners to attain desired goals;
- Increasing the efficiency of teachers in terms of numbers of learners taught, without reducing the quality of learning;
- Reducing costs without affecting quality; and
- Increasing the independence of learners and the flexibility of education and training provision (p. 3).

Learning in technology-rich environments has proven to have some impact on understanding. In his study, Warschauer (2004) investigated the role of technology in providing interaction to students learning second language. Different forms of technological tools such as web pages, emails, and newsgroups were found to have positive impact on students, especially those who were quiet and reserved in the normal classroom surrounding. Communication between students and teacher and even with strangers was possible in the learning process. His study also found that the technology-rich learning environment helped students to learn at their own pace and achieve higher levels.
Laurillard (2002) argues that technology has the capacity to improve learning only if proper integration into educational system was effectively done. Learner access to the technology and teacher supervision and guidance are important to achieve the full potential of the technology-rich environment. Learners’ approach and perception to learning, level of prior knowledge of the subject being studied and preparation of the learning tasks are issues that need to be considered before implementing a technology-rich learning environment.

Laurillard (2002) also argues that adequate resources are essential to provide technical support to achieve an ideal technology-rich environment that is conducive to learning. Without such expert services, there is no guarantee that the learning process could be handled without any interruptions. Other aspects that warrant attention in implementing a technology-rich learning environment are the effective organisation of the teaching experience and the careful evaluation of the learning material to ensure they are efficiently integrated into the course.

Research on teacher education courses has provided rich information on the use of technology in higher education. Three interesting and consistent findings emerge from these studies.

First, there is lack of use of computer technology among teacher educators, (Abdal-Haqq 1995; Duhaney, 2001; Krueger, Hansen & Smaldino, 2000). Even education faculties are unable to make appropriate use of technology in their own classrooms and unwilling to try because of anxiety, lack of interest or lack of motivation (Duhaney, 2001). Preservice teachers who experienced low levels of engagement with educational technology at university will most likely perceive technology as not so important when they teach their own students.

Second, the limited incorporation of technology education into teacher education curriculum (Duhaney, 2001; Krueger et al., 2000; Luke, Moore, &
Sawyer, 1998). Usually only one or two technology courses are offered to preservice teachers for the whole program and these courses are not related to the content of what is being taught (Abdal-Haqq 1995). This lack of a solid foundation in their preservice courses resulted in these teachers becoming hesitant when integrating technology into their own classrooms.

The third issue is limited access to technology where university education departments have less ICT resources than schools (Duhaney, 2001; Laffey & Musser, 1998). This issue has been a major excuse for preservice teachers not to include technology education as part of their subject selection. Another concern among preservice teachers is the lack of opportunities to apply technology skills learned during training. These issues affect not only the teaching aspect, but also the learning aspect in a technology-rich environment.

The issues discussed above parallels the teaching and learning process in business studies. From the researcher’s previous experience, lack of computer knowledge among faculty members has resulted in the technology provided by the university being underutilised. It is imperative that faculty members are aware of the technological capabilities provided by the university because they should live up to the new generation’s expectations. Students are becoming more and more technology savvy and they expect university life to be as easy as their normal, everyday life (Prensky, 2005). These are some of the barriers to effective teaching that need to be addressed.

In order to reduce the effect of these barriers and to enhance the affordances in technology education, knowledge of the theories and concepts of learning with technology is necessary to maximise the learning environment. The following section will explore the theories associated with learning with technology.
2.3 Theories of Learning with Technology

There are many definitions and conceptions of learning and different theories explain different aspects of learning (Jonassen et al., 2003). Several theories that inform our understanding of how technology impacts on learning have evolved over the century (Pea, 1985; Salomon, Perkins, & Globerson, 1991). According to Anderson and Lucas (1997), research in the area of cognition has opened avenues for further development in cognitive aspects of learning that potentially could have much impact for the study of learning within technological contexts. Their conception of the learner and the development of knowledge distinguish cognitive learning theories from other theories. From the cognitive perspective, the learner is considered to be actively involved in the construction of knowledge (Oostendorp, 2003; Salomon, 1993). Constructivism is one of the dominant influences on understanding the learner.

2.3.1 Constructivist Views of Learning

Constructivism refers to the theory that learners construct knowledge for themselves. Significant contributions to constructivism as a theory of learning have been made by Piaget (1929), and Vygotsky (1978). Constructivist theories of learning propose that learning occurs through the construction of knowledge based on their surroundings. Learners construct meaning while engaging with a new experience. They then relate this knowledge to their previous experiences. (Carnell & Lodge, 2002; Jonassen, 2000). Constructivism emphasises the following three points: 1) people actively construct knowledge for themselves, 2) knowledge is based on categories derived from social interaction not observation, and 3) people determine their own knowledge (Biggs & Moore, 1993, p. 22).

One of the major schools of constructivism that is relevant to this study is social constructivism (Gergen, 1995; Prawat & Floden, 1994). Central to constructivism is the belief that knowledge is constructed by learners as a result
of their interactions with the natural world mediated by their prior knowledge. Other perspectives on constructivism such as radical constructivism have been argued (von Glasersfeld, 1987) but are not deemed relevant in this study. Radical constructivism accepts multiple culturally viable interpretations of phenomena where truth or “rightness” lies in the personal interpretative beliefs and world view. The radical constructivist interpretation holds that multiple ideas are equally viable. Von Glasersfeld argues that constructivism needs to be radical and must explain that one can, indeed, manage without the traditional notion of Truth. His framework is more aligned with notions of constructionism and addresses ontological question concerning the nature of truth. Adopting a social constructivist perspective does not deny these radical perspectives but provides a pragmatic framework to inform teaching.

Social Constructivism emphasises the influences of cultural and social contexts in learning and supports a discovery model of learning (Rogoff, 1995). At present, socio-constructivist theories have a considerable impact on ICT-mediated education (Jonassen et al., 2003). Many of these have their roots in Vygotsky’s (1978) socio-constructivist theory. Vygotsky believed that social interaction and language are involved in the process of human development and learning. His theory is focused on the relationship between the individual and its social surroundings in the process of knowledge-building (Palincsar, 1998). Cultural and historical factors influence the development of knowledge that is shared between members of communities. Socio-constructivist theories based on Vygotsky (1978), therefore, view education as a cultural and cognitive developmental process. They argue that learning occurs within the interactions between teachers and students and the cultural values and social practices of the communities in educational institutions (Rojas-Drummond & Mercer, 2004).

Jonassen (1995) pointed out that learners use their own experiences, beliefs and knowledge when creating meanings of the real world. This process allows them to explore and understand different interpretations and to apply them in constructing knowledge. Jonassen (1995, 1999) further pointed out that learners
are actively creating their own perception and understanding of the subject. This is done by participating and interacting with the surrounding, not just being an active listener with limited view of the reality.

Several implications for learning within technical contexts emanating from the socio-constructivist theories (Candy, 1991; Driver & Oldham, 1986) of learning are summarised below:

1. The learner determines what is learned even though it might not be what the teacher intends to be learned;
2. The existing knowledge possessed by the learner determines what is learned, however new knowledge has some influence on learning event though not directly;
3. Learning involves prior experiences as well as experience gained after the formal learning process. The learning is continuous and active;
4. Learners must be encouraged to develop self-direction since they have final responsibility for their learning;
5. Shared social experiences allow communication and interaction that acknowledge mutual validity; and
6. Learners have reasons to ask questions and challenge teachers in the process of learning.

From the list above, it is observed that points 4 and 5 emphasise the importance of guided learning from a socio-constructivist point of view. Three derivatives of socio-constructivist theories focusing on guided learning and significantly impacting on the field of ICT-mediated education are communities of practice, situated learning and activity theory.

2.3.1.1 Communities of Practice

Communities of practice trace their roots to constructivism (Oliver & Herrington, 2000; Persichitte, 2000) and in particular socio-cultural constructivism (Lave & Wenger, 1991). The principal contention is that people
with similar interests and goals, when confronted with a learning task, collaborate over an extended period of time to share ideas and learn.

Lave and Wenger, (1991) argue that the learning process involved participation from experienced members of the community. Initially learners learn by being partially involved in the community doing tasks related to the practice of the community. Learners are guided by experienced members of the community. As time goes by, learners become more experienced and they will move to full participation in the community. They also argue that communities of practice surround learners on a daily basis. Learners’ role in the engagement with the experts in these communities depends on the groups they are in, sometimes as the main focus of the group, other times as observers. Communicating with experts in these groups results in new activities learned. Eventually, the learners’ affiliation with the society is reflected in the learned practices (Lave & Wenger, 1991; Wenger, 1998). In this situation, the role assumed by the learner is contextualised and situated in the circumstances being experienced.

More recently, the notion of communities of practice has been applied to businesses and organisations. Contemporary researchers argue that social capital is built through communities of practice. To build an understanding of how communities of practice create organisational values, Lesser and Storck (2001) have suggested thinking of a community “as an engine for the development of social capital” (p. 831). They argue that “the social capital resident in communities of practice leads to behavioural changes, which in turn positively influence business performance” (p. 831).

Hence, in a context where learners are peripheral participants in the culture of business, the development of opportunities to engage collectively in problem solving in authentic situations should contribute to an emerging sense of what is appropriate behaviour in their career situations. Highlighted in learning through communities of practice is the notion of situated learning.
2.3.1.2 Situated Learning

Situated learning or situated cognition has its past history in theories about communities of practice. The proponents of situated learning argue that learning occurs when people conceive what is happening in the environment surrounding them (Greeno, Smith, & Moore, 1992; Lave, 1988; Lave & Wenger, 1991). To a large extent, the concept of situated learning emphasises that learning occurs in a situation specific to what is learned. It provides teachers with a framework that promotes learning in an environment that closely resembles the context being learned (Schell & Black, 1997).

Lave and Wenger (1991) argue that situated learning is focused on learning that takes place within the activity, culture and context where it happens. Learning is said to be “situated” and understood, linked to these situations, supported by social relationships and interactions that exist in the situation. The role of social interaction is important in situated learning because learners are exposed to the society’s rules and behaviours. These societal constraints need to be learned and understood in the learning process.

Situated learning has been applied in the context of technology-based learning activities for schools that focus on problem-solving skills (Clancey, 1995). In short, the theory of situated cognition views learning as:

- Incorporating the learner’s identity and participation;
- Consisting of an everlasting membership and the ability to participate in different forms; and
- Representing ways in which the reproduction and development of communities of practice are made possible.

Related to this construct is the concept of activity theory which is further
explained in the following section.

2.3.1.3 Activity Theory

Activity theory was first proposed in the 1920s by Russian psychologist, Vygotsky from within a cultural-historical school of psychology. This idea was further developed by Leont’ev and Luria who coined the term “activity” (Leont’ev, 1989). They formulated a completely new theoretical concept that focuses on mediation of artefacts and object-oriented action (Vygotsky, 1978). Leont’ev (1989) emphasised the division of labour as a fundamental historical process behind the evolution of mental functions. Mediated by tools, work is also in collaboration with others. The distinction between activity, action and operation became the basis of Leont’ev’s (1989) model of activity.

Activity theory emphasises naturalistic study, culture, and history that offer a set of perspectives on human activity and a set of concepts for describing that activity. The components of any activity are organised into activity systems (Engeström, 1987), a model of which is depicted as a triangle. The primary focus of activity systems analysis is the triangle in which the activity is accomplished. The production of any activity involves a subject, the object of the activity, the tools that are used in the activity and the actions and operations that affect an outcome (Nardi, 1996a). Figure 2.1 outlines the basic structure of activity theory.
This model is based on the conceptualisation of activity theory by Engeström (1987). An activity is undertaken by a human actor motivated towards an object and mediated by a tool. The relationship between subject and community is mediated by “rules” and the relationship between object and community is mediated by the “division of labour”. A “tool” can be anything which is used in the transformation process, including both material tools and tools for thinking, “rules” cover both explicit and implicit norms, conventions and social relations within a community, and “division of labour” refers to the explicit and implicit organisation of a community as related to the transformation process of the object into the outcome. Each of the mediating term is historically formed and opens to further development (Engeström 1993, 1996; Nardi, 1996a).

Based on Engeström’s basic structure of activity theory, Jonassen and Rohrer-Murphy (1999), proposed a framework using activity theory for the design of constructive learning environments. They argue that there are less practical ways to construct and perform the analysis phase of the design and development process that are consistent with the fundamental assumptions for constructivist learning environments. They further outlined the following
characteristics for analysing learning situations from an activity theory perspective:

- The research time-frame should be long enough to understand the objects of activity and changes in those objects over time and their relations to objects in other settings. Activities and their objects in groups of workers necessarily overlap. Designers, for instance, may be working simultaneously on different design projects. Compare objects and goals of others with those you are examining;

- Analysts should pay attention first to broad patterns of activity before considering narrow episodic fragments which don’t reveal the overall direction and importance of the activity; and

- Analysts should use varied data collection methods (interviews, observations, video and historical materials) and points of view (subject, community, tools). The researcher needs to commit to understanding the activity system from all of these different perspectives. (pp. 68-69).

Based on the characteristics above, Jonassen and Rohrer-Murphy (1999) further argue that activity theory provides not only an appropriate, but also a powerful framework for analysing needs, tasks and outcomes for designing constructivist learning environments (Jonassen & Rohrer-Murphy, 1999).

Activity theory suggests that within a constructivist learning environment, the teacher plays an important role in achieving the desired learning outcomes for students. In a classroom setting, teachers act as mediators to help learners construct knowledge. McWilliam (2005) argue that the idea of “co-creating” between teachers and students would see both parties mutually involved in learning. She used the term “meddler in the middle” to emphasise the role of the teacher who works alongside students in classrooms as a provocateur; challenging, cuing, questioning, explaining and modelling cognitive and
affective processes. Therefore, the significance of the role of the teacher should be explored to better understand the magnitude of their contribution to learning.

2.3.2 Roles of Teacher in Constructivist Learning

Driver, Asoko, Leach, Mortimer, and Scott (1994) argue that the teacher in a constructivist learning environment has many important roles to play during the construction of knowledge by the learners. The teacher is a member of the team, and not the focus of the classroom. For example, it is essential for the teacher to act as a guide to support and promote learning and to analyse the current classroom instruction for further improvement. They also indicate that the teacher needs to adopt the role of a more knowledgeable peer inducting the learners into a community of practice.

Constructivists such as Driver et al. (1994) believe that teachers must actively guide the learner in the process of learning effectively. The construction of viable mental models and the discovery of facts are seen as necessary to achieve effective learning. They also believe that teachers have a difficult and complex task than their normal traditional one, since they must comprehend each learner’s existing cognitive structures in order to provide effective guidance.

The following are three frameworks considered useful for exploring the role of the teacher. They are cognitive apprenticeship, student-centred learning and zone of proximal development and scaffolding. As will be argued these approaches have substantial supporting literature validating their potential to inform teaching.

2.3.2.1 Cognitive Apprenticeship

Brown, Collins and Duguid (1989) emphasised the need for a new epistemology for learning ~ one that emphasises active perception over
concepts and representation. Cognitive apprenticeship is a pedagogical model developed within the situated learning paradigm. The model is inspired by the apprentice-master model of traditional crafts but it is adapted to “cognitive” or intellectual domains, where there is little direct teaching between master and apprentice.

Cognitive apprenticeship is representative of Vygotskian “zone of proximal development” (as explained later) in which learners’ tasks are slightly more difficult than they can manage independently. Brown et al. (1989) argue that learners require the aid of their peers and teacher to succeed in doing the tasks. For example, Brown, et al., (1989) emphasised the idea of cognitive apprenticeship:

Cognitive apprenticeship supports learning in a domain by enabling students to acquire, develop and use cognitive tools in authentic domain activity. Learning, both outside and inside school, advances through collaborative social interaction and the social construction of knowledge. (p. 34)

Collins, Brown and Newman, (1989), proposed six motivational methods including scaffolding. These were:

1. Modeling - involves an expert’s carrying out a task so that learner can observe and build a conceptual model of the processes that are required to accomplish the task;
2. Coaching - consists of observing learners while they carry out a task and offering hints, feedback, modelling, reminders, etc.;
3. Articulation - includes any method of getting learners to articulate their knowledge, reasoning, or problem-solving processes;
4. Reflection - enables learners to compare their own problem-solving processes with those of an expert or another learner; and
5. Exploration - involves pushing learners into a mode of problem solving on their own. Forcing them to do exploration is critical; if they are to
learn how to frame questions or problems that are interesting and that they can solve (pp. 481-482).

The concept of cognitive apprenticeship can be linked to learner-centred learning where learning occurs with minimal help from the teacher.

2.3.2.2 Student-centred Learning

Student-centred learning is a learning process where learners seek solutions to problems with minimal assistance from the teacher. In this process, learners are given direct access to the knowledge base and work individually and in small groups to solve authentic problems. Learners learn to reason individually using their own experiences to successfully find solutions to the problems. In short, learners construct their own meaning by talking, listening, writing, reading, and reflecting on content, ideas, issues, and concerns (Meyers & Jones, 1993). Proper application of this concept may possibly contribute to meaningful learning in a life-long learning process (Alexander & Murphy, 1998). Many of the key notions about the role of the teacher in constructivist learning environments set out in Driver et al. (1994), have their genesis in Vygotsky’s (1978) socio-constructivist theory.

2.3.2.3 The Zone of Proximal Development and Scaffolding

One of the key constructs subsumed within Vygotsky’s (1978) theory is the zone of proximal development (ZPD). The concept of ZPD explains the different levels of mental stages between self-guided problem solving compared to teacher-guided problem solving. Learners’ readiness to learn reflects the upper levels of competence. With help from the teacher, learners become more knowledgeable and the upper levels of competence change to adapt to their abilities. Eventually, learners will no longer need any assistance in solving the problem. The actual developmental level characterises mental development retrospectively, while the zone of proximal development characterises mental development prospectively (Vygotsky, 1978). Vygotsky claimed that learning
occurred in this zone and it is the teacher’s responsibility to provide support and
guidance to fill the gap in the learner’s learning. Vygotsky’s theory of the ZPD
has also influenced the development and implementation of constructivist
learning environments (Driscoll, 1994).

Teacher support and guidance in the learning process is known as scaffolding.
The notion of scaffolding emanates from Vygotsky’s concept of the zone of
proximal development. Scaffolding is one of the effective strategies to access
the zone of proximal development (Hausfather, 1996). This concept recognises
the important role of the teacher as an assistant in enabling the learner to focus
on areas of potential development, thus maximising learner’s understanding
(Rojas-Drummond & Mercer, 2004).

The effect of scaffolding can be seen through two major areas: enabling the
learner to undertake a task successfully, and extending the current capabilities
of the learner. Thus scaffolding expands the zone of proximal development
since the provision of teaching tools and well thought out instructions enable
higher order problems to be solved more rapidly (Hausfather, 1996). Scaffolding also enables the learner to reach beyond their current competencies
and explore new understandings and skills.

Roehler and Cantlon (1997) suggest that scaffolding is important in supporting
student learning by helping them to understand and learn from others. The
collaboration formed by working with others when solving problems leads to
students actively constructing knowledge, to make connections, and to build
mental schemata. Students whose learning is helped by scaffolding through
collaboration will have an advantage over those who do not.

Scaffolding includes other actions such as teacher involvement with
simplifying, planning, organising, doing and/or reflecting on any specific task.
The teacher has a duty to engage the learner in the learning process through
A critical aspect to the concept of scaffolding is “fading.” This is a process where the teacher slowly “fades” away assigning more responsibility and autonomy on the learner. Learners can then self-reliantly explore, set their own sub-goals and frame problems. In this way the learner gradually becomes an expert in the performance of a specific task. However, the level of fading depends on the individual learner in such a way that each learner is facilitated in performance and learning without being stifled by too much scaffolding or failing due to too little scaffolding (Guzdial & Kehoe, 1998).

By simulating a real life environment, VR provides the cues and concrete experiences that enable learners to develop plans, organise thoughts and manipulate the situation.

From the discussion above, teachers can teach in ways which are called ‘constructivist’ by being aware of, and teaching in a manner consistent with knowledge of how their students learn. An effective teacher in a VR environment should be characterised by one who acts as a guide in promoting learning, as part of a team member, as an expert in the field, and have the ability to understand each learner’s different learning approaches.

### 2.4 Roles of Learner in Constructivist Learning

From the view of constructivists, knowledge is actively created or invented by the learner, not passively received from the environment. How and what is learnt during the process of knowledge construction is shaped by the learner’s previous experiences (Clements & Battista, 1990; Driver, et al., 1994). Given the perspectives outlined in section 2.3.1, constructivism has implications for
the role of the learner.

Therefore, many roles adopted by learners with traditional instructional methods such as memorising and imitating are considered incompatible with the notion that learning is a process of knowledge construction influenced by cultural and social contexts (Bruner, 1996; Jonassen, et al. 2003). Within constructivist learning environments where learners are engaged in the process of knowledge construction and the building of knowledge artefacts (Bereiter, 2002; Scardamalia, 2002), learners are required to take on roles other than that of memorising and imitating. In fact they are required to adopt roles such as an active learner (Bruner, 1990; Jonassen, 1995), a problem finder (Bereiter, 2002; Bereiter & Scardamalia, 1996; Scardamalia, 2002), a problem definer, an explorer of ideas, a critic, a risk-taker, an experimenter, a meaning maker, a theory/model builder and in some cases a more knowledgeable peer inducting their peers into a community of practice (Driver et al., 1994).

Within constructivist theories, learners’ autonomy and initiative are accepted and encouraged (Jonassen, 1995). Constructivist theories, therefore, place much emphasis on the responsibility of the learner for constructing knowledge; learners are expected to know what is important for them and they also are expected to set goals in order to achieve the outcome (Jonassen et al., 2003). Furthermore, they are expected to take an active role in constructing meaning and the teacher’s role primarily is viewed as someone who aids learners to refine their thinking or their performance to make it more effective (Jonassen et al., 2003). Two important features are motivation and active engagement.

2.4.1 Motivation

Learners are said to be motivated when they believe that they are able to engage, persist and accomplish certain tasks (Bandura, 1986). This theory of self-efficacy suggests that student learning can be increased if they believe that they have the ability to manage their thinking strategies. Motivation can be
described as intrinsic or extrinsic in nature (Sansone & Harackiewicz, 2000). Malone and Lepper (1987) define intrinsic motivation as something that learners will do without getting external rewards, other than interest and enjoyment. Extrinsic motivation, on the other hand, is something that learners will do as a result of the attainment of external rewards (Sansone & Harackiewicz, 2000).

2.4.2 Active Engagement

Learners are said to be actively engaged in the learning process when there is a dynamic interaction occurring between them and the surroundings. A constructivist learning view emphasises this dynamic interaction that impacts on learning. Bereiter and Scardamalia (Bereiter, 2002; Bereiter & Scardamalia, 1996; Scardamalia, 2002) identified five roles for learners actively engaged in a constructivist learning environment. The first role is to learn from constructing knowledge through manipulating equipment or materials provided to them. It is perceived that learning occurs in such activity even though there is likely no substantiation or manifestation of knowledge, except maybe by the teacher. The second role is to learn with guidance or hands-on learning to help in discovering knowledge. Learners ask questions in the process of discovering knowledge and guidance is provided in order to reach a conclusion. However, there is a tendency to focus on the process rather than on the knowledge emerging from it, and to abandon inquiry as soon as the principle has been found.

The third role is learning through problem solving. Learners, either individually or as a group, learn to solve problematic tasks from the easiest to the most difficult. Learners need to learn how to work with diversity, complexity and messiness in order to come up with a better and wider understanding of the problems they are trying to solve. Group members should also share ideas and proactively contribute towards the advancement of the group’s collective knowledge. The fourth role is information gathering from
curiosity-driven inquiries. Learners also gather information from reading, observation or empirical research to satisfy their curiosity and answer the questions they have. The fifth and final role is the improvement of theories. This is achieved through group interaction where learners propose initial theories and discussions and inquiries that follow improve these theories. As members of a group, learners also need to deal with problems of goals, motivation, evaluation, and long-range planning that are normally handled by teachers. They also need to be prepared to take risks and consider that all ideas are improvable.

The role assumed by the learner in a constructivist learning environment linked with a technology-rich environment will result in enhanced learning. Constructivism and technology education is further explored below. The effective learner will therefore be one who is highly motivated and actively engaged in seeking to understand content, is metacognitive and self-regulating and is able to capitalise on affordances provided by the environment such as effective teachers and technology.

2.5 Constructivism and Technology Education

The importance of technology was recognised long ago when advocates argued that wholesale revision of educational practice was necessary to focus on learning outcomes achieved through practices in which technology was embedded as a tool to support deeper more reflective self-directed activity (Strommen & Lincoln, 1992).

The use of technology in education should attempt to shift the focus from knowledge-as-possession to knowledge-as-construction, and from learning as outside-guided to learning as self-guided (Jonassen et al., 2003). In a technology-rich environment, the constructivist view of learning focuses on the importance of how equipment is used rather than what equipment is used.
Thus the focus moves to the learner rather than the teacher or the technological tool itself (Campoy, 1992; Jonassen et al., 2003; Tam, 2000). It carries a renewed conception of instruction that shifts attention from instruction as the imparting of knowledge to instruction as the guidance of socially-based exploration in intellectually rich settings (Salomon et al., 1991). Among the diversity of cognitive learning theories, the constructivist view is the most widely adapted to learning in technology-enhanced environments (Jonassen, 1995).

As was noted earlier, learners in a constructivist setting are self empowered and are responsible for their own actions. Based on this principle, a constructivist learning paradigm linked with a technologically enhanced learning environment will enable learners to utilise constructivist principles in the learning process (Atherton, 1999; Duffy & Jonassen, 1992; Salomon, 1997; Salomon et al., 1991). Learners in a technology-rich environment are provided with tools that allow them to build their own mental models. Learners engaged in learning have the opportunity to inquire and to develop understanding from their own and others’ perspectives when constructing knowledge. Thus, the goal in technology-rich learning environments is to allow learners to have freedom and the opportunity in using the tools, to ground their experience in a manner appropriate to them in order to achieve meaningful learning. Learners in this type of environment are able to access data and find information with little help from the teacher.

However, the role of the teacher should not be underestimated. Teachers must relinquish authority in order to allow learners to explore and learn (Jonassen et al., 2003). As was noted earlier, teachers in a constructivist-learning environment act as a guide to learners. This role is even more important in a technology-rich environment where it provides for learner control and at the same time exposes learners to different kinds of technology in the classroom where teachers are needed to help learners construct more viable conceptions of the world. In a technology-rich learning environment, teachers employ
different teaching methods such as computer-aided lectures and tutorials (Jonassen, 1995), online learning (Thrøha, 2003), and provision of task guidance in a simulated environment (Dalgarno, 2002). These methods of instructions may be integrated based on the type of technology available in the classroom. Also, teachers have the responsibility to assist learners identify and remedy learner errors and misconceptions (Bruner, 1986; Ernest, 1995; Jonassen et al., 2003; Wilson & Cole, 1991).

Constructivism and educational technology together have increased the effectiveness of the learning process (Jonassen, 1995). Thus, constructivist learning and teaching principles can readily be adapted to suit different technology-enhanced learning environments. One effective utilisation of constructivist principles is the multimedia learning environment. Dede (1990) argues that because of the different structure of multimedia learning environment, they are supportive of constructivist learning principles, in particular the ability to search and combine variety of media lends itself to opportunities for students to explore multiple experiences.

Indeed in a multimedia supported learning environment the roles of individuals, their learning experiences and technology in achieving quality outcomes can be accommodated as a process of knowledge management. Learning outcomes result from a transformative process where inputs such as visual, auditory and textual information is transformed into new models of practice applicable to the students’ career needs (Diezmann & Watters, in press).

2.5.1 Multimedia Learning Technology

Mayer (2001) defined multimedia learning as the presentation of material using both “words” and “pictures”. He defined “words” as the material presented in verbal form, such as using printed or spoken text and “pictures” as the material presented in pictorial form, such as using static graphics, including illustrations,
graphs, photos, or maps or using dynamic graphics, including animation or video.

A multimedia system incorporates different types of media such as audio, video, graphics and animation available in multimedia hardware and software. According to Mayer (1997), deeper understanding occurs when learners mentally connect pictorial and verbal representations of the explanation. This process is more likely to occur for multimedia presentations than for presentations in words alone. Many studies utilising multimedia system conducted over the years support this idea. One of them, conducted by Moreno, Mayer, Spires, and Lester (2001), studied college students learning how to design the roots, stem, and leaves of plants to survive in eight different environments through a computer-based multimedia lesson. The experimental group learned by interacting with an animated pedagogical agent who spoke to them while the control group received identical graphics and explanations as on-screen text without a pedagogical agent. Results of this study reveal that students who learned by interacting with an animated pedagogical agent who spoke to them performed better that the group who only received on-screen text without any pedagogical agent.

These results point to the importance of multimedia representations in helping learners to understand explanations and allow us to offer the multimedia principle: Learners learn more deeply from multimedia presentations involving words and graphics than from words alone (Mayer, Spires & Lester, 2001). To find out how learning can best be understood in a multimedia learning environment, several cognitive theories of learning process are explained below.

### 2.5.2 Cognitive Theories and Multimedia Learning

Cognitive learning theories explain learning in terms of changes in cognitive processes. This section will focus on five different cognitive theories of
learning that are of relevance to the study. They are:

- Information processing theory;
- Dual coding theory;
- Working memory load;
- Cognitive schema theory; and
- Cognitive theory of multimedia learning.

These theories are interrelated and they explain the cognitive processes of learning in a VR environment.

2.5.2.1 Information Processing Theory

The information processing theory of learning postulates how people attend to environmental events, encode information to be learned and relate it to knowledge in memory, store new knowledge in memory and retrieve it as needed (Shuell, 1986). This theory deals with sequence and execution of cognitive events. Learning evolved from the analogy between how information is processed in humans and computers. Biggs and Moore (1993) likened the processing of information in the brain with that of the central processing unit (CPU) in the computer. Information is selectively collected from the environment, processed and stored to be accessed later. Figure 2.2 shows the information processing theory and its flow between the different stages.
The three stages in information-processing model are similar to those previously described namely; 1) sensory register, 2) working or short-term memory and 3) long-term memory. The first stage, the sensory register lasts for approximately one second. The second stage, the short-term memory, has storage of approximately half a minute unless information is repeated (Baddeley, 1992, 1997). This structure is where conscious thinking takes place (Biggs & Moore, 1993). This is also where important information is selected by means of sensory stimuli and a high degree of selection is necessary because the working memory’s limited capacity to process only one train of thought at a time (Biggs & Moore, 1993). The information at this stage is raw and unprocessed. Finally, the third stage is reached where information is stored in the long-term memory for an unlimited time.

Information processing theory recognises several implications for learning and instruction that includes providing organised instruction, identifying the limits
of attention and the limits of short-term memory, and matching encoding strategies with the material to be learned. These implications led to the idea of dual coding theory that provides further explanation as to how the information is processed in the human brain.

2.5.2.2 Dual Coding Theory

According to Paivio (1971, 1986; Clark & Paivio, 1991), dual coding theory describes two cognitive sub-systems in human cognition; one specialised for the representation and processing of nonverbal objects/events and the other specialised for dealing with language. Because of this, learners are said to collect information using all the sense organs including the eyes, ears, taste buds, and pain nerves in the skin to absorb information. Figure 2.3 outlines dual coding theory.

Figure 2.3. Dual coding theory (Mayer, 1997).

Information collected through the sense organs are processed three ways: (1) representational, the direct activation of verbal or non-verbal representations, (2) referential, the activation of the verbal system by the nonverbal system or
vice-versa, and (3) associative processing, the activation of representations within the same verbal or nonverbal system. A given task may require any or all of the three kinds of processing (Clark & Paivio, 1991). This information is then transferred into the short-term memory where it is processed and further stored in the long-term memory. The stored information then becomes part of the person’s knowledge that can be retrieved at a later time. Sensory stimulation can be enhanced by providing an environment enriched with stimuli.

Dual coding theory not only allows learners to acquire information using two channels but it also releases the learner of their working memory load which leads to better learning (Bagui, 1998; Paivio, 1990). For example, information that uses text and relevant illustrations (verbal and pictorial channel) will likely be learned better than information that uses text alone (verbal channel only), audio alone (verbal channel only), combined text and audio (verbal channel only), or illustrations alone (pictorial channel only).

This idea is supported by one of Paivio’s studies (Paivio, 1975). In this study, Paivio successively presented concrete items that included repeated pictures, repeated words, and picture-word combinations. People recalled more items that were successively presented as picture-word combinations compared to repeated pictures or repeated words. Paivio believes that this effect resulted because people differentially encoded the successive picture-word combinations. This study (Paivio, 1975) also found that people recalled more successively repeated pictures than successively repeated words. Paivio believed that this behaviour is because people recall pictures better than words.

In another study conducted by Mayer and Gallini (1990), college students read text with and without illustrations that explained the operation of automobile drum brakes. For college students with low prior knowledge of automobile drum brake operation, the illustrations improved their recall of explanatory information and their ability to solve problems related to the explanations. For
college students with high prior knowledge, the explanatory illustrations did not affect their performance. Results of this study suggested that dual coding can improve learning in a multimedia environment.

Najjar (1996) argues that specific situations in which multimedia information may help people to learn include:

- When the media encourage dual coding of information;
- When the media support one another; and
- When the media are presented to learners with low prior knowledge or aptitude in the domain being learned.

He also argues that there is empirical support for concluding that specific multimedia can be used to help people learn specific kinds of information (Najjar, 1996).

2.5.2.3 Working Memory Load

The limited capacity in processing high level cognitive activity is the most important feature of working memory. Thus it is important to optimise its use. Learners will need as much working memory as possible to store data in order to aid understanding.

The working memory is where conscious thinking takes place (Sweller, 1988, 1994). It is needed for all cognitive activity, especially for higher-level thinking. Working memory should be occupied with the more important rather than the less important aspects of a problem. One of the most effective ways of improving learning and problem solving is to reduce the working memory load (Baddeley, 1986, 1992; Reed 2006). This reduction allows the mind to process other, more complex problems than it otherwise could.

de Fockert, Rees, Frith, and Lavie (2001) studied the role of working memory
in visual selective attention. In their study, participants were tested on the capability of their working memory load. Selective attention tasks associated with two different levels of working memory load, low and high, were performed repeatedly. Participants were introduced with distracter faces while trying to retain a set of numbers in the working memory load. Results of this experiment agreed with the idea that working memory load plays an important part in controlling visual selective attention.

One way to reduce working memory load is to pass information into the long-term memory (Sweller 1994, 1999). How information is processed is based on the schematic structure of the long-term memory, which is explained by the cognitive schema theory below (Brunken, Plass, & Leutner, 2003).

2.5.2.4 Cognitive Schema Theory

Derry (1996) listed the three schemas as memory objects, mental models, and cognitive fields. The first, memory objects are the outcome of learning stored permanently in memory and a learner can recall the information at any time. The second schema, mental models, are particular organisations of memory objects that constitute a specific event interpretation while the third, cognitive fields represent ideas that are likely to be recalled during mental modelling. This schematic structure provides encoding strategies when retrieving information from long-term memory.

Sweller (1988, 1994, 1999; Sweller, van Merrienboer, & Paas, 1998) found that in order for learning to happen, there must be a connection with the schematic structures of long-term memory. If the connection is not made, the learner will likely forget the material, and learning will not occur. In order to achieve the schematic change, and produce effortless performance, the learner must become more familiar with what is being studied. As a result of this familiarisation, the cognitive processes associated with the information become altered, and the information is handled more efficiently by working memory which, in turn,
facilitates the connection to long-term memory schemas (Brunken et al., 2003; Sweller 1999). Therefore, learners should group or chunk information in smaller portions so working memory is not overloaded and information can be passed to long-term memory more efficiently allowing learning to occur.

The grouping of information can best be done in an authentic learning environment with VR as part of the teaching/learning approaches. Further explanation of such learning environment is explored below.

2.5.2.5 Cognitive Theory of Multimedia Learning

Mayer (2001) suggests the need for a cognitive theory of multimedia learning that builds-on and adapts key notions from cognitive theories into the field of multimedia. This theory suggests that when exposed to more than one form of media, learners are able to understand and make meaning of the topic learned.

According to Mayer (2001), the mind processes information in the form of multimedia presentation through the sensory memory, working memory and long-term memory. The sensory memory selects the images and words through the eyes and ears. These images and words are then processed in the working memory where they are organised and arranged in order to make meaning. The information is then integrated with pictorial model and verbal model, together with prior knowledge and experience before leaving them in the long-term memory (Mayer 2001; Mayer, Mathias, & Wetzell, 2002). Figure 2.4 outlines the concept of cognitive theory of multimedia learning.
Mayer, (2001) also argues that it is better to present an explanation in words and pictures than solely in words. This principle, referred to as “Multiple Representation Principle”, states that it is better to present an explanation using two modes of representation rather than one. For example, students who listened to a narration explaining how a bicycle tire pump works while also viewing a corresponding animation generated twice as many useful solutions to subsequent problem solving transfer questions than did students who listened to the same narration without viewing any animation (Mayer & Anderson, 1991).

Similarly, this principle is consistent with Mayer, Dow, and Mayer (2003), who studied students learning about electric motors by asking questions and receiving answers from an on-screen pedagogical agent named Dr. Phyz. This agent stood next to an on-screen drawing of an electric motor and Dr. Phyz’s explanation was presented as narration rather than on-screen text. Students performed better on a problem-solving transfer test when Dr. Phyz’s explanations were presented as narration rather than on-screen text. Results of this experiment are consistent with the cognitive theory of multimedia learning.

The multimedia effect is consistent with cognitive theory of multimedia learning because students who were given multimedia explanations were able to build a verbal and visual model and build connections between them. This
theory suggests that when exposed to more than one form of media, learners are able to understand and make meaning of the topic learned.

The five cognitive theories explained above; information processing theory, dual coding theory, working memory load, cognitive schema theory, and multimedia learning theory explored different cognitive models that facilitate learning in a multimedia environment. The coalescence of these models explains ways information is processed in a multimedia-enhanced environment and can lead to designing better learning environments incorporating technology such as VR scenarios.

2.5.3 Synthesis of Cognitive Theories of Multimedia Learning

The cognitive theories presented above support multimedia learning based on several common shared principles in processing information; they are the importance of verbal and nonverbal cues, the need of schematic representation for easy retrieval of information and the sequential processing of information.

These principles, in turn, are focused on the capacity of the short-term memory and the ability of the long-term memory in processing, storing, and retrieving information. The shared principles are also essential in manipulating information necessary for such complex tasks as comprehension, learning and reasoning in a VR learning environment.

Learning is better when information is processed using verbal and nonverbal cues. Furthermore, the application of schemas enables easy retrieval of information from long-term memory. Information stored in the long-term memory can be easily retrieved if schematic representation of the information is consistent.
VR as an extension of multimedia technology provides a powerful aid in releasing the working memory load from having to visualise the real environment. This helps free the limited capacity of the working memory load to process crucial information in the learning process.

Consequently, ICT-based learning environments share a common assumption – they help enhance learning in the classroom setting by speeding up cognitive processes. Most ICT-based learning environments provide some form of multimedia embedded in them; therefore, knowledge about the cognitive processes will assist in designing the learning environments. The following explores ICT-based authentic learning environments which are concerned with real-life environments.

### 2.6 Authentic ICT-based Learning Environments

Authentic learning environments draw their theoretical foundation from social constructivist epistemologies and in particular acknowledge that learning is contextualised (Schön, 1991). Authentic learning environments allow students to explore, discover, and discuss ideas to generate meaningful information which relates to their real-life experience (Honebein, Duffy, & Fishman, 1993). Educationists argue the importance of providing students with authentic learning environments that allow the acquisition and application of skills based on real-life or workplace situations, problems and tasks (Herrington, Oliver & Reeves, 2003). Authentic learning environments enable learners to have some control over what and how they learn. When a sense of personal control is established, learners should be able to pursue their own independent learning endeavours, albeit guided by a supportive teacher. The teacher necessarily plays an important role in manipulating the learning environment to provide opportunities for learners to explore their own interests and to be challenged.
Authentic learning environments are manifested in many different ways. With the advent of more powerful and less expensive ICT, much effort has been expended in the research of development of ICT-based authentic learning environments. Technology offers great advantages for authentic learning environments that were not available before. Technology can provide scaffolds for the students, and can allow students access to the latest tools. The use of new technologies in authentic learning environments has the power to stimulate the development of intellectual skills such as reasoning and problem solving ability (Gregoire, Bracewell, & Laferriere, 1996). However, technological tools alone do not guarantee authenticity. Barab, Squire and Dueber (2000) argue that the authenticity of a learning environment does not depend on the individual components in that environment; rather the dynamic interaction between the components determines the authenticity. This interaction is present in a blended learning environment where different modes of instructions blend together to deliver an authentic learning environment.

Such experiences in an authentic, technology-enhanced blended learning environment are important in narrowing the gap between classroom experiences and the workplace to allow for learning that lasts (Herrington & Herrington, 1998). Authentic learning activities are designed within the constructivist, problem-based learning and learner-centred domains. They are characterised as follows (Herrington and Oliver, 2000; Herrington & Herrington, 2006):

- The tasks should be accomplished over a period of time with relevance to the real world;
- The tasks should be ill-defined and should allow students to approach it from different perspectives;
- The tasks should encourage students to collaborate and the diversity of learning outcome be allowed;
- The tasks should be able to be incorporated with other units allowing smooth integration of assessment to produce polished products;
• The tasks should provide a model who behaves like a real practitioner in a real situation;
• The tasks should provide the opportunity for articulation and reflection on students’ learning; and
• Teacher and students should provide scaffolding and coaching when doing the tasks.

Furthermore, Herrington and Herrington (2006) promote the notion that suspension of disbelief is needed in order for students to fully engage themselves in scenarios based on authentic tasks. The suspension of disbelief is similar to the experience of moviegoers that allow them to be immersed into the realm of the world through the big screen. In drawing a line of parity between the experience of movie going and immersion in VR environments, it is easy to understand the success of gaming and simulation tools and the role-playing aspect of these environments. But placed within a learning situation the suspension of disbelief is not as easily accepted and students face many problems arising mainly from the difficulty of adjusting from traditionally derived practices and habits (Herrington, et al., 2003).

Despite of this setback, the importance of suspension of disbelief in an authentic learning environment cannot be ignored. One way to experience the suspension of disbelief is through a multimedia-enhanced environment. The capabilities of computer-based multimedia learning environments to store, interconnect, and provide access to a wide range of knowledge represented as text, graphics, audio, and video allows the release of unnecessary burden on the limited capacity of the working memory (Herrington & Herrington, 1998). Research on multimedia learning environments support the idea that learning within this environment can be effective by allowing learners to become engaged in the tasks at hand (Najjar, 1996, 2001; Sherry, 1996), provide significant affordances to enrich learners’ learning compared to traditional learning (Fletcher, Hawley, & Piele, 1990; Khalili & Shashaani, 1994), and provide extra information to learners through the senses that ultimately helps to
process information effectively (Herrington & Herrington, 1998). Another form of multimedia learning, VR learning environment, has even the advanced capacity to immerse learners through the suspension of disbelief.

Research has also shown that the VR learning environment involves all the sense organs of the learner more than a multimedia-learning environment would (Byrne, 1996, 1993). This environment which has more advanced characteristics than the multimedia environment is hypothesised as a powerful aid in releasing the working memory load from having to visualise the real environment (Mayer, 2001). Thus, there is a need to trace the literature back to multimedia learning for the purpose of this research as was stated in section 2.4.1.

From the perspective of the research cited in section 2.4.1, the visualisation is done for the learners, thus the working memory is given the opportunity to do other higher order thinking, in this case decision-making in a crisis situation. Representation of the real world scenario will allow the working memory to free itself from having to process and visualise the environment given in a printed case study. The exposure to VR experience will, therefore, release the burden on the working memory. This characteristic is important in promoting effective learning among learners in an educational setting. Several studies utilising VR technology in education support this idea.

2.6.1 The Use of VR in Education

Virtual reality is a powerful educational tool (Bricken, 1991; Dede, Salzman, Loftin & Ash, 1999). A number of prominent studies using VR in teaching and learning have supported this proposition. This section addresses these studies in detail. VR learning environment concepts are being introduced into the education system around the world and are being adopted into the mainstream of the educational process. Classrooms are quickly being transformed into
virtual technology-enabled learning environments and students are exposed to learning modes never before experienced (Lemonick & Gregory, 1992; Sykes, 1999).

A VR environment generates direct experience of a computational environment, which can be manipulated for the maximum benefit of education. One example is enhanced students’ abilities to conceptualise and integrate complex and abstract scientific ideas (Dede et al., 1999). VR learning environments have been utilised in the field of education because of the non-availability of such activities to students for the following reasons (Bricken & Byrne, 1992; Byrne, 1993; Dede et al., 1999):

- Access to situations that would otherwise be dangerous;
- Situations where observation of internal workings/structure is important to aid understanding;
- Situations where interaction is important to aid understanding;
- Applications which are so complex that conventional teaching methods are inadequate;
- Difficulties with certain real-world experiences (e.g., time–based or economically-based); and
- Situations that cannot be experienced in real life at all (e.g., nuclear fission).

The adoption of VR learning environment as replacements for the real physical world may enhance some learning experiences. Computer simulation of the real world has shown to be equally as effective as real life (Bricken, 1990), enhance the learning achievement levels of students (Bowman et al., 1999), enhance the problem solving skills of students (Gokhale, 1996) and foster peer interaction (Andolsek, 1995). Positive educational impact resulting from VR
learning environment would be invaluable in the training of students from many areas.

Given situations or circumstances where exploration of real environments is impractical, dangerous or inaccessible, VR technology provides an alternative experience. VR technology has the potential to provide real world simulations with real world complexity and limitations that are present in real life (Herrington & Oliver, 2000). Honebein et al. (1993) argue that students learning in such environments should be able to demonstrate the knowledge learned to face their future professional life. Different competencies developed through authentic learning environments that represent real life problems are vital in ensuring learning that lasts. Due to the very limited body of research focusing on the application of VR technology in the classroom, those as far back as 1992 are explored below.

Dalgarno (2004) studied the use of a 3D virtual environment that represents a chemistry laboratory to a group of tertiary students. The focus of his study was the effect of learning task design within a 3D environment on spatial learning. Participants undertook tests to determine the degree to which they formed a spatial cognitive model of the laboratory and its apparatus. The findings of this study argue that the advantages of 3D environments over video depend on the degree to which the environments allow tasks to be performed that directly align with the desired learning outcomes. If such tasks can be identified then learning advantages can occur, but only if learners are explicitly advised to undertake these tasks either through guidance provided within the environment or as part of supporting materials. He also argues that free exploration of a 3D environment with no explicit task advice is unlikely to lead to learning advantages over video or interactive multimedia.

Dickey (1999) studied 3D virtual worlds and learning. The purpose of her study was to examine both the design and educational practice of 3D softwares. She compared and contrasted these three software packages in trying to find out the unique opportunities available in education through the use of 3D virtual
worlds. She also looked at the different learning environment provided through these software packages. Findings from her study supported the idea that visual support via the 3D software was crucial to learning. She also argues that learning was not separated from context or from process and function, and students were able to learn by being situated in the context that was suitable to what they were learning. It was also found that 3D virtual worlds support the notion of experiential learning supported by more traditional immersive forms of VR. She recommended future research to investigate the use of 3D environments for educational use.

Johnson, et al. (1998) studied primary school children (6-10 years) in a “CAVE” (Computer Automatic Virtual Environment) immersive VR environment called project “NICE” (Narrative Immersive Constructionist / Collaborative Environments). The VR environment presented a simplified ecological model where children were involved in planting and tending of a garden. Children were represented by avatars (graphical image of a user) in the VR environment and they used head mounted displays and gloves to interact. There were genies available for them to interact in the process of learning in the VR environment. Results of this study showed that children were extremely motivated and deeply engaged. Teachers in the form of avatars in the VR environment acted as mentors and they were effective.

Byrne (1996) investigated the effectiveness of VR as an educational tool. In her study, high school students created water molecules in an immersive virtual environment. They were tested on their knowledge of atomic and molecular structure before and after their VR experience. The results were compared to the test results of students who experienced other educational media in learning the same topic. Findings from this study support the idea that students exposed to the VR treatment did significantly better in their post test scores. It was found that the interactivity in the VR environment, and not immersion, that helped students understand the process of learning atomic and molecular structure.
Bricken and Byrne (1992) studied a group of primary school students during the summer semester for students aged 5-18. The focus was hands-on exploration about new technology especially VR. Students worked in groups of two or three and used VR to construct and explore their own virtual worlds, with help from the teachers. The study was conducted in one-week sessions. Information was gathered during a 7-week period in order to evaluate VR in terms of usefulness and appeal to students aged 10-15 and to document the students’ behaviour and opinions. Results of this study indicated that VR helped students develop rapid comprehension of complex concepts and skills. It was also argued that VR environment provided a significantly compelling and creative environment in which to teach and learn.

Results from these research studies provide a further insight into the effectiveness of a VR environment. Three major assertions can be derived from previous findings. Firstly, Dalgarno, (2004) argues that the VR environment should be aligned to the tasks to achieve the desired outcome. This assertion is similar to Dickey (1999) who studied different VR software used for specific subjects. She argues that students were able to learn when they were situated in the context of the subjects learned in the VR environment.

Secondly, the suitability of the type of VR environment to the subject being learned is acknowledged. There were many different types of VR environment reported in the literature but the type of VR must be suitable to the subject learned. For example, Bricken and Byrne (1993) suggest that interactive VR tools such as the HMD and data gloves must be used if the subject being studied involves arm movements and spatial recognition. Byrne (1992) proposed that interactivity was an important part in making students involved in the environment and providing authentic life like experiences.

Finally, the role of the facilitator in the VR environment was seen as important (Dalgarno, 2004; Johnson et al., 1998). The facilitator helped guide students to keep to the tasks. The presence of the facilitator in this study has helped
students to keep to the tasks at hand. He guided the discussions in the VR environment and navigated students in the VR environment. Students interacted with him when looking for information or seeking further information.

The application of VR as a learning environment is likely to increase in some universities (Spicer & Stratford, 2001). The potential of exploring the benefits of VR learning environments cannot be understated as exemplified by Dalgarno and Hedberg (2001). They emphasised the benefits of allowing students to explore difficult to visit places, microscopic objects, modelling of concepts through object manipulation, and placing the student into situations that are dangerous or high risk. VR environments situate learning within a meaningful context so that information and ideas are readily recalled and applied in the real world. In other words, the “real” world is experienced allowing processes of cognition and reflection to take place, be practiced, and applied prior to being in it.

2.6.1.1 Disadvantages of VR Learning Environment

VR learning environments also have some disadvantages. Some of the disadvantages include high costs and motion sickness (Kolasinski, 1994).

Costs of VR equipment is a major constraint in adopting VR learning environment (Beckett, 1992; Dalgarno & Hedberg, 2001). Beckett (1992) argues that the high costs associated with VR equipment can raise a lot of issues. Problems such as theft of the equipment, mishandling of the delicate equipment, and maintenance issues are among the drawbacks to VR learning environment.

Motion sickness associated with VR simulation is another problem (Campos, 2000; Passig, Noyman, & Eden, 2002). VR simulation induces dizziness in some people while others feel ill after operating VR learning environment.
component. Kolasinski (1994) argues that motion sickness is normal in a VR environment.

Despite the disadvantages of VR, it is seen that in the near future VR learning environments will become more commonplace and go beyond the high technology applications that are currently being used. Although the body of literature abounds with the potential use of VR as learning environments, more research is needed in order to determine to what extent VR assists in encoding and how it aids in understanding, recall, and knowledge application. With further research practitioners can decide whether the advantages outweigh the disadvantages.

Therefore, the study of different learning approaches in VR learning environments will become even more important in every field, especially in learning marketing decision-making skills.

In creating an authentic learning environment, learning needs to be designed around rich problem situations that afford multiple opportunities for students’ construction of knowledge through inquiry, discussion, and argument (Palincsar, 1998; Palincsar, Magnusson, Marano, Ford, & Brown, 1997; von Glasersfeld, 1988). This study focuses on the incorporation of other teaching/learning approaches, apart from the VR learning environment. It explores the concept of blended learning where different approaches to teaching/learning such as lectures/tutorials, online discussion forum, industry panel presentation and VR environment are incorporated to achieve authentic learning environment. The following section explores in detail the concept of blended learning in education.
2.6.2 The Concept of Blended Learning in Education

Blended learning involves the integration of online learning and other forms of instruction to provide enhanced access to learning. However, there are at least five limitations in blended learning which are human scaffolding of learning, miscommunication, effective pedagogy, inappropriate content and information overload. Each of these limitations will be briefly discussed.

First, the lack of “human touch” in online learning currently adds to the increasing need of blended learning. Clark and Mayer (2002) note the failure to accommodate human learning process in online learning. Second, issues with discourse and the construction of knowledge through communication have limitations. Mann (2003) raised the issue of the missing cues normally present in verbal communication on interpretations of written discourse in online learning. Third, lack of consideration of effective pedagogical principles when implementing online learning has resulted in the potential of technology-supported learning not maximised (Oliver & Herrington, 2003). Fourth, according to Clark and Mayer (2002), designers often fail to base online learning on the specific learning outcomes required in a particular context. It is argued that online learning must be pre-planned to include job analysis to make it successful. Finally, high attrition rates have been attributed to the limited capacity of the human brain to assimilate the overload of information, and as a result of frustration among online students (Adelskold, Aleklett, Axelsson, & Blomgren, 1999; Clark & Mayer, 2002).

One of the ways to overcome these pitfalls is by blending online learning with other modes of delivery, especially face-to-face learning. Blended learning is a relatively new concept of learning where instruction is delivered through a blend of online learning and traditional instructor-led classroom approaches (Bielawski & Metcalf, 2003; Thorne, 2003; Throha, 2003). This delivery mode complements the “human touch” of online learning. This learning concept can be adjusted to the level of comfort in accessing and using of technology among
students (Throha, 2003). The flexibility of the process brings a multitude of benefits not only to the students, but to the teachers as well (Waddoups, Hatch, & Butterworth, 2003). The different approaches can accommodate different learning styles of different individuals (Salmon, 2003). Students have the opportunity to learn at their own pace. Through blended learning, the learner can absorb the new information without finding the learning experience onerous. The blending of instructions can incorporate different forms of ICT tools such as collaboration software, web-based learning programmes and knowledge management practices, with the guidance of a facilitator in the learning process.

With the different types of ICT tools involved, the facilitators are usually seen as providing the human touch to the learning process. They provide guidance to learners especially when dealing with the ICT tools. However, Mallinen (2001) found that the facilitators’ roles are not the same as in face-to-face learning.

Blended learning has been widely adopted by organisations in training their employees. Blended learning has resulted from the need for a more flexible delivery of knowledge (Garrison & Kanuka, 2004). Due to its flexibility, it is argued that blended learning not only is suitable for employees who are adult students, but it has also proven to be meaningful for students from different age groups (Waddoups, et al., 2003). Through blended learning, students are able to grasp new content and absorb new information in without having to spend extra time and energy than they should. The use of convenient, user-friendly media in blended learning adds to the effectiveness of the approach. Face-to-face interaction in online learning is said to have a positive impact on the students when understanding difficult concepts (Throha, 2003).

However, Throha (2003) argues that not all blended learning initiatives have been successful, in fact many failed largely due to poor instructional design of the program. Instructional designers failed to address the real need for blended learning. Oliver and Trigwell (2005) argue that the term blended learning
describes the modes of instruction in which students are engaged in a range of situations or strategies that purport to foster learning.

### 2.6.2.1 Approaches to Blended Learning

Designing blended learning does not require a specific approach. There are many different approaches with the basic approach involving online learning with other instructional methods. Other forms of instructions such as face-to-face instructions and group work can be incorporated into the design. It is important that the blended learning design meet the learning objectives, the subject content, the facilities, and the budget available (Clark & Mayer, 2002).

Developing a highly effective and efficient blended learning solution requires focus on design and development of the instructional materials (Orey, 2002; Throha, 2003). The design of the content must be interactive, problem-centred and pertinent to the learner. It is also important to identify the type of media and the mode of delivery to ensure quality (Osguthorpe & Graham, 2003).

### 2.7 Marketing Decision-Making in a Crisis Situation

The term “marketing” is defined as the “sense of satisfying customer needs by creating value through interacting and working with the customer” (Kotler, Brown, Adam, & Armstrong, 2004, p. 7). In achieving the aim of satisfying customer needs, high quality decision-making is necessary in any relevant circumstances. Thus, the process of learning decision-making in marketing involves the ability to make quality decisions in related situations especially in crisis situations.

A crisis situation is a point in a developing series of events where significant change becomes possible, and which, therefore, calls for decisions by those in authority. In a crisis situation, there is a need for rapid judgment and decision by the authorities (Westefeld & Heckman-Stone, 2003).
Among the most widely used and influential conceptualisations of a crisis is Hermann’s (1963) model. Working with adverse international events, Hermann proposed three conditions for a crisis: (1) threatens high priority values or the organisation goals, (2) presents a restricted amount of time in which a decision can be made, and (3) is unexpected or unanticipated by the organisation (p. 64).

Decision-makers consider threat as a recognised aspect that prohibits the achievement of the desired goal (Barnett & Pratt, 2000). Restricted amount of time available for decision-making occurs when the situation will be changed in the near future (Hermann & Brady, 1972). Surprise refers to the fact that decision-makers are not aware of the possible crisis situation. It is not the same as lack of planning when responding to the situation. Even if there is a planned response, the surprise effect can still occur and this can lead to a crisis. In Hermann’s model all three attributes must be present in order for a crisis to exist.

According to Sniezek, et al. (2001) regardless of the domain, crises usually consists of four criteria:

- Lack of or uncertain information in a crisis event including the cause of the problem and the severity of the problem;
- Fast, successive onset of events which requires immediate response;
- Impending serious losses that are unavoidable; and
- Difficulty in arranging for effective action due to lack of control.

Based on the information above it can be concluded that learning decision-making in a crisis situation is impossible without the learners experiencing the crisis situation in real life. The advantage of learning in an immersive environment allows learners to experience the simulated environment and felt like they are really experiencing the crisis situation. On the other hand, learning decision-making is another step.
2.7.1 Crisis Decision-making Process

Quality decision-making needs quick and easy access to information. Today, marketing information is facing radical changes. The high cost of good information must be balanced against its value to the company (Perreault & McCarthy, 2002). Thus quality decision-making using the important and costly information is crucial to the well-being of the company.

Decision-making models help decision-makers in making quality decision-making. The use of these models depends on the characteristics of the decision problem. There are two types of models, qualitative and quantitative. These types are used based on the form of data available. Some decision-making models are used only once, when a difficult decision has to be thoroughly analysed (Greenberg et al., 2002) while others are meant for continuous use on a regular basis (Michalowski, Rubin, Slowinski, & Wilk, 2003; Zupan et al., 2001). Nowadays the abundance of available information and the advances in data analysis methods enable the use of data in various ways to aid in decision-making process (Han & Kamber, 2001).

Marketing decision-making in a crisis situation is an important skill and it requires tools and terminology (Kerin, Hartley, & Rudelius, 2004). Skill in decision-making is viewed as crucial in arriving at a better decision. Drucker (1985) argues that the burden of decision-making can be lessened and better decisions can result if a manager recognises that the process to arrive at a decision requires rational and systematic sequence of steps.

The decision-making process consists of several steps that begin with defining the objectives, creating alternative courses of action, assessing the feasibility and estimating the effects of the alternatives, and having the option of the alternative that contributes most to the achievement of the objectives (Nill & Schultz, 1997).
Several aspects in the process of decision-making for crises-specific problems were outlined by Nill and Schultz (1997). They are concerned with the focusing of the cognitive processes, information distortion, group pathologies, and rigidities in programming. These aspects affected the objectives, choice of alternatives and evaluation of the consequences in the decision-making process. Lack of decision readiness heightens the stress associated with the crisis situation.

Many researchers and business scholars have argued that marketing might be the most unethical of all the business functions especially when it comes to decision-making in a crisis situation (Nill et. al, 2004). When making decisions, marketing managers are often burdened with meeting the organizational demands and at the same time the interests of the stakeholders (Lund, 2000). The business community, especially the teaching professors are responsible to come up with a better way of teaching decision-making skills to business students (Nill & Schultz, 1997; Schibrowsky & Peltier, 1995). Thus the process of learning decision-making in a crisis situation should be continuously developed so learners are able to make better decisions and for the case studies used to teach decision-making to represent the real world. The decision-making process starts with defining the problem at hand, enumerate the decision factors, consider relevant information, identify the best alternative, developing a plan for the alternative, and finally, evaluate the decision process. From these stages, decisions are made based on the alternatives available (Kerin et al., 2004).

It has been stated that technology can be used to facilitate and improve the quality of decision-making by reducing information overload and by augmenting the cognitive limitations and rationality bounds of decision-makers (Levy & Powell, 1998; Singh, 1998).

As the latest development in technology, VR can be applied in decision-making through the use of complex real time multidimensional data mining. It is
reported and argued that visualisation is a powerful new tool that can be used to help decision-makers (Gershon, Eick, & Card, 1998). Theoretical arguments in support of this have been previously outlined in this chapter. VR environment provides increased understanding of complex data sets and simplifies critical decision-making. According to Lamberti and Wallace (1987), one of the characteristics of visualisation is the ability to incorporate uncertainties into the software. With visualisation, learners are not required to read large amounts of data in order to understand the information (Gershon et al. 1998; Zhang, 1996). The dynamic and innovative interface encourages communication in team collaboration, such as brainstorming and idea-sharing, that contributes to quality decision-making. Apart from that, VR can be accessed remotely which means it can connect geographically dispersed experts, reduce costs and enable urgent problems to be solved quickly. The large screen immersive environment allows distributed interaction between people which supports for collaboration and dynamic team work (Lambert, 2002). Awareness attained through such environment helps the participant to assimilate data from a scenario, analyse the significance of the data and to implement urgent decisions (Rojas & Mukherjee, 2002).

The availability of real-life situations will considerably help learners of decision-making to learn effective skill of decision-making before becoming executives of real, multinational companies.

2.7.2 Case Studies Method in Teaching and Learning

Case studies method in teaching and learning have been used to provide authentic learning by inserting slices of realism to facts and data into the problems or tasks at hand (Bennett, Harper, & Hedberg, 2002; Stewart 2003). Case studies method are traditionally associated with business schools in which students need to explore how issues and principles learned in class and interact in real world situations (Harvard Business Online, 2006). There are three elements in case method teaching: (1) cases are based on real-world situation,
In traditional case method teaching, print-based case studies are used where learners are expected to read and gain understanding of the actual marketing problems (Kerin et al., 2004). In every case study, the decision-maker develops a strategy consistent with the underlying factors existing in the situation presented and must consider the implications of that strategy for the organisation and its environment. Learners are expected to become acquainted with the situation and background of the company before understanding the problem. Similarly, Jonassen, Chad and Yueh (1998) argue that learners should be presented with situations that resemble the real world as close as possible. The problems should be ill-structured, interesting, relevant, and meaningful to solve and there is no right answer for a problem using this approach.

Similar to traditional cases, multimedia cases are based on real business problems. However, multimedia cases:

…unleash the power of video, sound, and computer simulation to bring home the circumstances of the industrial setting.

(Harvard Business Online, 2006, para 1).

In this study, teaching and learning decision making used the case method approach. The VR environment simulation provided the industrial setting where students had the real world experience in solving the problem. The theoretical framework is discussed next.

### 2.8 Theoretical Framework

The overall aim of the study is to evaluate the role of VR learning environment in learning marketing decision-making as part of an authentic learning environment. In order to address this overall aim, a theoretical framework that
has its antecedents in the literature review in general and in activity theory in particular was developed for the research study. This framework is presented in Figure 2.5.

Figure 2.5. Embedding VR technology using activity theory approach - a theoretical framework.

This framework conceptualises the DM333: Marketing Decision Making as an activity system in which the learners, tools and mediators, and the blended learning environment based around the VR simulation dynamically interact to facilitate the learning of marketing decision-making knowledge and skills. This theoretical framework identifies three major roles; the role of the environment, the role of the learners, and the role of the tools and mediators. These roles dynamically interact with each other within the boundaries of the socio-constructivist view of learning in a technology-rich environment.

Within this framework, relevant theories reviewed earlier in this chapter are applied when exploring the interaction between the three different roles.
Theories describing the roles of the teacher and facilitator as tools and mediators include cognitive apprenticeship, student-centred learning, and zone of proximal development and scaffolding; theories exploring the roles of the learner as subject are motivation and active engagement; while theories describing the role of the learning environment include blended learning, situated learning, and activity theory. Each role represents a component of an activity system and can be understood and analysed in terms of activity theory.

From this over-riding theoretical framework, the following specific research questions were generated:

1. How do participants interact with the components of a VR learning environment situated within the context of a business studies unit that focuses on the development of decision-making skills in crisis events?

2. What relationships exist between virtual reality learning environment and other components of a unit of study that focuses on the development of decision-making skills in crisis events?

3. What theoretical conclusions can be drawn on the effectiveness of virtual reality scenarios in similar contexts where VR learning environments are blended with other teaching/learning approaches?
Chapter 3: METHODOLOGY

‘What we have to learn to do, we learn by doing.’
- Aristotle

3.1 Chapter Overview

As outlined in chapter 1, the overall aim of this study was to investigate through the lenses provided by activity theory (Engeström, 1987, 2001) how students’ interactions in a VR learning environment situated in the context of a business studies unit influence the learning of decision-making skills in crisis events.

The research examined the implementation of VR at two levels: within activity system and between-activity system levels. The within-activity level focused on the transactions that occurred during the implementation of a VR session (Research question 1). The between-activity system level focused on the way VR was integrated into the unit of study (Research question 2).

This chapter reports on the research methodology and methods for the study. Section 3.2 discusses qualitative research approach and the appropriateness of this paradigm for the study. Section 3.3 describes the participants involved in this study. Information about the VR simulation being used and the facilities are described in section 3.4. Section 3.5 outlines the sequence of events while section 3.6 describes the methods for collecting data to be utilised in the study. Procedures for the analysis of data are described in section 3.7. The limitations of this study are discussed in section 3.8.
3.2 Qualitative Research Approach

Qualitative research method involves the studied use and collection of a variety of empirical materials that describe routine and problematic areas and meanings in individuals’ lives (Denzin & Lincoln, 2000). It is an in-depth analysis of the objects being studied. This study could be considered as a case study incorporating the experiences and structures of a unit within a Bachelor of Business course.

The researcher attempts to observe, describe, and interpret settings as they are. Qualitative research reports are descriptive, incorporating expressive language, and deploy a wide range of interconnected interpretive practices, aimed at discovering the meaning events have for the individuals who experience them and the interpretations of those meanings by the researcher.

One of the major benefits of qualitative research methods is that it provides very detailed information about people, events, and practices (Guba, 1978; Lincoln & Guba, 1982). This detailed information is crucial especially in this research where interactions between actors in the learning environment are studied. Because this approach examines these actors and practices in their natural context (Hoepfl, 1997), it can identify and describe the complex interactions and interrelationships among factors in a system. The unrestricted and open-ended nature of qualitative research permits researchers to explore fresh new findings that are not possible with quantitative research. This aspect of qualitative research is essential especially when examining new, innovative, and exceptional situations (Kozma & Anderson, 2002).

Qualitative research approach is appropriate for a range of research occurrences. Of particular importance are areas where an understanding of the investigation of a central phenomenon is concerned (Creswell, 2002). Strauss and Corbin (1990) proposed that qualitative research method is not only
suitable to gain deeper knowledge, but also excellent way of exploring different perspectives on existing situation that could bring about exciting findings.

### 3.3 Overview of the Intervention

The blended learning approach for this research involves combining online learning with other instructional methods. As mentioned before, there is no specific approach in designing blended learning, however the focus must be on the use of a range of instructional approaches. An overview of the blended learning approach in this study is presented in this section and involves a number of components as shown in Table 3.1.

Table 3.1

*The blend of instructional approaches*

<table>
<thead>
<tr>
<th>Teaching/learning approaches</th>
<th>Delivery</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures/tutorials</td>
<td>Teacher</td>
<td>Classroom with PowerPoint®/Computer laboratory</td>
</tr>
<tr>
<td>Online discussion forum</td>
<td>Online</td>
<td>Individual homes/computer laboratory</td>
</tr>
<tr>
<td>Industry panel presentation</td>
<td>Industry Panel</td>
<td>Faculty of Business meeting room</td>
</tr>
<tr>
<td>VR environment</td>
<td>Facilitator</td>
<td>Commercial VR theatre</td>
</tr>
</tbody>
</table>

*Note: Adapted from this research.*

Four different learning approaches were employed and they were delivered at different places with the VR environment being the focus of instruction. Participants were briefed on these approaches at the beginning of the semester.

Participants in this study were:
1. The students – 2nd and 3rd year business students at a large technology-based university in Australia. All 18, eight females and ten males, were selected based on their enrolment in this unit. Details of the unit are described in Appendix B. Students as the major participants in this study had studied for a Bachelor of Business degree for the past three or four semesters before the research was conducted. Majority of them (80%) are Caucasian Australians and 20% are international students from Asian countries. All except two are full time students. All students enrolled in this unit must pass the basic Marketing subject taught in semester 1. Therefore, all of them possessed knowledge about basic Marketing. Third year students, on the other hand, had advanced knowledge of Marketing, however, the faculty did not offer decision-making in Marketing subjects prior to this unit. In short, this was the first time for all students in this study to learn Marketing Decision-Making;

2. The teacher - a part-time teacher for the course;

3. The facilitator - a recently-retired lecturer who previously taught the same unit and was involved in the development of the course; and

4. The software developer - who helped navigate the VR simulation was a staff member of the University. He was the key player in developing and running the VR simulation.

3.4 Context and VR Learning Environment

This research utilises one-of-a-kind, specially developed in-house VR simulation software by a programmer employed by the University. This simulation was developed specifically for the purpose of this research. Teachers, facilitator and developer alike gave their ideas and input in the development process. The context of the simulation was designed to resemble as close as possible to the unit’s context. The design was based on Dickey’s (1999) argument that learning should be in the same context as the virtual world and should be suitable to what students were learning. During the development
stage, visits to a real food canning factory were made in order to get a real sense of the simulation.

3.4.1 The Software

The VR prototype was developed using VRML (virtual reality modelling language) and is given the name *Virtual Golden Foods Corporation* comprising a food canning factory, in this case jam canning, and managers’ offices. In its current stage of development, these two environments were selected as the environments where the crisis scenarios are to take place. The crisis forms part of the case study. The case study and VR were piloted before the main study (Godat, Yahaya, Euler, & Singh, 2007; Yahaya, Euler, & Godat, 2004).

3.4.2 The Facilities

The VR commercial theatre utilised in this research was situated in a technology park about two kilometres south of the University. This theatre can accommodate up to twenty participants and were still able to effectively provide the immersed feeling in a VR simulated environment. There was a 10-feet high, semi-spherical screen specially used for VR presentations. At that time of this research, the University had ready access to these facilities.

3.4.3 The Simulated Scenario

The food canning factory in the software provides a number of scenarios and triggers of events that can take place in a food production line. The first event was the jam-processing machine breakdown. The breakdown led to several other problems including a factory fire. Participants were introduced to the scenario during tutorials in Week 8, via a desktop computer which was beamed onto a white screen in the computer laboratory. They were also exposed to the same text-based case study on the first day of lecture. The purpose was to familiarise themselves with the situation surrounding the event.
In the VR theatre, participants were seated on swivel chairs facing a large curved screen which occupied the width of the room. The facilitator stood slightly to the left of the group and was facing the screen. When the session started the image was projected onto the screen and provided the participants with a sense of 3D depth. The software developer sat at a console on an elevated platform in the theatre. The facilitator guided the session by interacting with the students and providing instructions to the console operator. As the scenario unfolded and the crisis situation became evident the facilitator drew attention to various events and prompted the students with questions about the operation of the factory.

The students were required to discuss among themselves what decisions could be made after the entire crisis scenario was presented. They were given about 20 minutes for the discussion. A set of quantitative decision-making models were provided on a side screen where students could request the facilitator to key in estimated financial data before coming up with decisions. Scenarios and events were based on the tasks that students were required to complete. Audio and visual feedback make up the clues to the crisis as the user navigates through the factory with the help of the software developer.

When in the VR theatre, students were briefed on what to expect. Then they were shown the VR simulation for about 20 minutes, after which they were given about 20 minutes more to decide on what decisions to make based on the incidents that occurred. During this discussion, several quantitative decision-making models using databases and spreadsheets were provided on a separate screen on the side of the theatre. A list of responses from different management levels pertaining to the incidents was built-in within the VR simulation. Students have access to these responses at anytime during the discussion. They made decisions based on these tools, the quantitative model, and the responses. Figure 3.1 shows the scenario in the VR theatre.
Figure 3.1. Scenario in the VR environment.

For the VR intervention, data were collected from observation. Three video cameras were strategically placed in the VR theatre to capture students’ responses and the facilitator’s role during the decision-making stage. Focus groups sessions were held right after the VR intervention to gain insights into what students thought of the VR intervention.

A website was later created for students and staff to review the VR learning experience (refer appendix C and D). This website was not used as part of this research; however, it was developed for future use. This website at the time of writing is visible at https://olt.qut.edu.au/udf/VGFC/ and has won the ASCILITE award for exemplary application of ICT in teaching and learning at the 2005 Australasian Society for Computers in Learning in Tertiary Education (ASCILITE) conference in Brisbane, Australia. The ASCILITE awards are designed to reward leaders in the use of electronic technologies in teaching and learning in tertiary education awarded every year at the ASCILITE conference,. Judged by an International Panel of experts in the field of using ICT to support
teaching and learning, these awards recognise exemplary product design and development in the application of ICT in teaching and learning (Australasian Society for Computers in Learning in Tertiary Education - ASCILITE, 2005).

It was envisioned that *Virtual Golden Foods Corporation* would be developed into an integrated virtual corporation which could also be used in various other disciplines within the Business Faculty. Figure 3.2 shows the virtual corporation with its various departments and divisions allowing for an interdisciplinary environment to be created. The central crisis environment is the food-canning factory.

![Virtual Golden Foods Corporation](image)

*Figure 3.2. The environment of Virtual Golden Foods Corporation.*

*Virtual Golden Foods Corporation* can be accessed through a link on the unit’s website housed in the University’s courseware management software. The program resides on a High Performance Computing Department server and can be accessed through the University’s Online Learning Technology (OLT). It provides students with crisis scenarios allowing them to visualise, feel and critically examine the issues surrounding a crisis event.
Figures 3.3 through 3.8 provide a selection of the snapshots of the VR simulated factory environment. The crisis situations that can be observed in some of the snapshots include the pressure vats with gas leak, localised fire in the steriliser area, and non-functional wrapper.

*Figure 3.3. Overview of the VR simulated factory.*
Figure 3.4. Pressure vats with gas leak.

Figure 3.5. Localised fire in steriliser area.
Figure 3.6. Non-functional wrapper.

Figure 3.7. Fire control with fire seen in background.
Figure 3.8. Fire in warehouse.
3.5 Sequence of intervention

An overview of events that occurred during the implementation of DM333 is shown in Figure 3.9.

![Diagram](image_url)

*Figure 3.9. Overview of events for DM333.*

The teaching events were performed in a natural classroom setting which included lectures and tutorials held three hours a week for the whole semester. The online discussion forums were held in Week 4 and 10 while the VR environment session in Week 11. The industry panel presentation was held during Week 12. The next few paragraphs explain the teaching events involved.

The semester began with a briefing of the VR intervention on the first day of class. As a measure of existing knowledge, participants were given the Jaboticaba Jam case study (refer appendix A) to be solved. In this printed case study, there was no mention of the crisis scenario to maintain the surprise effect. They were given 20 minutes to write the solution to the case study. The same case study was used in the VR intervention at the end of the semester. Direct observation began immediately on the first day of class, after the research briefing.
The online discussion forums were held in Week 4 and 6 to allow students to express their opinions online with other members in the class. Every student had the opportunity to submit their contributions based on the preamble provided by the teacher.

During Week 8, students were exposed to the VR environment to eliminate the “novelty effect.” However, the exposure was via a desktop computer in the computer laboratory which did not give the “immersive” effect. Research on informal learning environments has provided insights into the impact on learning of the “novelty effect”. Anderson and Lucas (1997) argue that pre-orientation activities designed to reduce the novelty effect has enhanced students’ learning in environments such as the museums. Csikszentmihalyi and Hermanson (1995) identified that curiosity played an important role in attracting students’ attention to exhibitions in museums. The level of curiosity depends on the level of devotion of cognitive resources to new stimuli surrounding them. This allocation of cognitive resources to new stimuli is consistent with the idea that human beings are naturally attracted to loud noises or motion (Cole & Cole, 1996). However, to allow the cognitive resources to be fully utilised and for the learner to achieve the state of intellectual and emotional arousal, the activity must be designed to motivate the learners by being interesting, exciting and satisfying for them. (Csikszentmihalyi & Hermanson, 1995; Deci & Ryan, 1985; Schiefele & Rheinberg, 1997).

Students were exposed to a trial of the VR environment for the purpose of familiarising them with the environment. They were divided into two separate groups to maximise the immersiveness of the VR environment. They were provided with an opportunity to use the facility in solving a task unrelated to the content of the course. The purpose was to enhance their familiarity with the equipment and provide basic information on the use of the equipment. At this stage, students were briefed about the whole environment and informed of the expectations.
During the VR intervention, the Jaboticaba Jam case study (refer appendix A) was given to students one week prior to the VR environment. This case study was prepared by the VR facilitator and it outlined information such as the background of the company, the situation, and the tasks that students were expected to do. Students were required to familiarise themselves with the case study before exposure to the VR environment. The purpose of the handout was to inform the students of the expectations when they were in the VR theatre. Students took the case study handout into the VR theatre and they used it as a reference when discussing the problem and making decisions.

The industry panel presentation was held in Week 12. At the beginning of the semester in Week 2, students were told to form groups of 4 or 5 to prepare a report on a selected decision-making model for the presentation. Students presented their reports as a group in front of a panel of six industry experts with each having a minimum of 10 years experience. The purpose of this event was to expose students to feedback and comments from the industry experts so they can learn from their experiences. This is consistent with the idea of communities of practice where learners learn from the experts (Lave & Wenger, 1991).

### 3.6 Data Sources

Data were collected through the following processes:

- Pre-study and post-study survey questionnaires conducted on participants (n=18).
- Formal and informal interviews of participants (n=18), the teacher and the facilitator before and after the VR session;
- Focus group sessions for participants (n=18) conducted after the VR session and at the end of the semester;
- Regular observations of classroom to document teaching intervention and student interactions (to validate intervention); and
- Artefacts taken from participants such as the case being studied, answers provided and students’ work.
Gathering data from multiple sources is an effective method to ensure the authenticity of the research. As opposed to use of isolated sources of data that often can only provide a single perspective to the issue being investigated, the utilisation of multiple sources of data will ensure triangulation of data that provides credibility in analysing and theorising about the issue being investigated (Marshall & Rossman, 1999).

3.6.1 Survey Instruments

Surveys are a very efficient method of finding out background information about participants in a research study (Cohen, Manion, & Morrison, 2000). Therefore, a short survey was administered to the participants (n=18) before the session. The purpose of this survey was to collect background information about students especially their exposure to ICT. It is significant to know the level of ICT knowledge for each student to gauge their reaction to the technology-aided environment.

3.6.2 Interviews

Interviews are considered as an essential source of data for a case study since normally case studies involve human beings (Yin 2003). Formal interviews conducted in this study involved asking a fixed written set of questions on specific topics that was recorded in detail while informal interviews where open-ended questions were asked around specific topics but in a flexible enough manner so as to allow other issues to be addressed (Yin, 2003; Creswell, 2002). Informal, open-ended interviews enabled the researcher to focus directly on the topic being researched (Patton, 1990). It also provides perceived causal inferences because participants can provide important insights into the situation being studied (Morton-Williams, 1993; Yin, 2003). For this study, formal interviews were conducted before participants’ interactions with VR learning environment (n=18). Informal interviews with participants (n=18) were conducted individually throughout the semester, the teacher and the facilitator and the outcome was noted.
and recorded. The names of participants were accurately included on the transcripts to enable cross-referencing of comments. The data gathered from the interview were analysed to ascertain the participants’ prior knowledge about the subject matter and their perceptions on VR learning environment. The transcriptions were analysed by developing codes and categories of the description. These categories emerged from the data but were also informed by literature.

3.6.3 Focus Groups

At the end of the VR intervention, two focus group sessions were conducted. Participants were asked about their experiences with the VR learning environment during the session, what they think the purpose of the activity was, and what and how they had learnt during the session. These data were analysed in order to identify:

- Participants’ perceptions about the purpose of the activity;
- Participants’ perception of their relationships with the facilitator and with fellow classmates; and
- Participants’ perceptions about how and what they did and how and what they learnt.

3.6.4 Observation

Direct observation was chosen as part of data collection because it exposes events in real time. Direct observation of classrooms is an established methodology for documenting the teaching learning process. One of the advantages of direct observation method is the ability to record events as it occurs in its natural setting. (Creswell, 2002). A running record of the classroom observation was recorded against a timeline of every 15 minutes. The interpersonal behaviour and motives of participants can be recorded. Therefore, during the course of the study, participants operating within a VR environment were recorded via video camera. Direct observation by the researcher was conducted in all the lectures/tutorials as well as in the VR environment. The observation protocol includes the reflection on content
delivery in the lecture hall, in the computer lab, and in the VR learning environment. Interaction between teacher and participants, between facilitator and participants were noted and recorded. The analysis of the observation data focused on the identification of the patterns of students’ responses to VR learning environment.

3.6.5 Artefacts

Artefacts are defined as objects that can be used as tools. Shukla, Nardi, and Redmiles (1998) proposed four levels of artefacts based on the work of Engeström (1990). The four categories are basic tool, how-to, why, and where-to artefacts. These categories are represented through four different levels; level one artefacts are the physical tools, level two are the procedures, norms and methods, level three are the models such as motivations and incentives and level four represent reflection in action or future environments.

The artefacts identified in this research were level one and level two artefacts. Level one artefacts were part of the assessment instruments that included the unit outline, case studies, handouts, and other work involved including final examination results. Level two artefacts were the procedures and rules surrounding the learning process. These artefacts were collected and analysed to provide data about what they have done and how and what they have learnt.

3.7 Analysis of Data

The analysis of data was conducted at two levels: macro- and micro-levels. To remind the reader, the macro-level represents the holistic experience of the students within the unit. The micro-level relates to experience within each component of the unit, for example, the VR environment subsystem. Activity theory (Engeström, 2001) was used to frame analysis at both levels. Figure 3.10 depicts the adaptation of activity theory to this research at the macro-level. Representations of the application of activity theory to components are described in chapter 4.
Figure 3.10. Adaptation of activity theory to this research.

For research question 2 a modification of Jonassen and Rohrer-Murphy’s (1999) adaptation of activity theory was utilised. This approach identified a number of sub-steps for each of the above steps in the analysis of the constructivist learning environment. Because their framework was developed to inform the design of constructivist learning environments, adaptations had to be made to the framework to address the questions of this research study. The adapted framework is discussed in detail in section 3.7.1.

At the micro-level, this study has adopted Strauss and Corbin’s (1990) techniques to code the data as follows:

- Concepts: Conceptual labels placed on discrete happenings, events, and other instances of phenomena;
- Categories: A classification of concepts. This classification is discovered when concepts are compared one against another and appear to pertain to a
similar phenomenon. Thus the concepts are grouped together under a higher order, more abstract concept called a category;

- Coding: a process of analysing data;
- Code Notes: the products of coding in the form of memos;
- Open Coding: The process of breaking down, examining, comparing, conceptualising, and categorising data;
- Properties: Attributes or characteristics pertaining to a category; and
- Dimensions: Location of properties along a continuum. In this study a continuum is sometimes referred to as a “trajectory”.
- Dimensionalising: The process of breaking a property down into its dimensions. (p. 61)

Data analysis at the micro-level thus consisted of making a detailed description of the case and its context. Interviews were recorded and transcribed immediately and studied, compared, and categorised. Interview transcriptions were transcribed verbatim and where necessary, the utterances were edited and proofread to clarify meaning. They were read and reread to find specific themes. The coding was repeated to look for patterns and transcripts were examined individually and in relation to others to gauge common themes across the class.

Videotapes also were analysed and transcribed, and in class observation notes were taken. Artefacts were examined extensively. Emerging issues were reported and grouped into categories. Difficulties were identified and reported. Individual case studies of four participants were composed and these were identified as salient contributors to the way students engaged with VR.

The analyses were shared and discussed with the supervisors as part of a process of evaluating and testing assumptions.
3.7.1 Modification of Jonassen and Rohrer-Murphy’s Adaptation of Activity Theory

The analysis of data with respect to research question 2 (the between-activity system focus) was informed by strategies adapted from a framework developed by Jonassen and Rohrer-Murphy (1999). They proposed a framework based on activity theory for the design of constructivist learning environments which they argue provides an appropriate strategy for analysing needs, tasks and outcomes. The usefulness of the theory was due to the assumption that activity theory is associated with those of constructivism, situated learning, distributed cognitions, social cognition, and everyday cognition that underlie constructivist learning environments.

The reasons for applying this approach were:

- The VR simulation was a form of technology specifically used to provide simulation to the research study. The difference of this branch of technology in aiding learning was specific to case study learning processes;
- The psychological nature of the decision-making process, especially when using the decision-making tools was evident in solving the case studies in the tutorials and in the VR exposure;
- Analysis of learners as users in this research, from the beginning of the semester right until the end of the semester revealed how activity and its surrounding helped shape their understanding learning decision-making theories; and
- The relationship with the VR environment as the major computer tool and cultural influences among the subjects.

Jonassen and Rohrer-Murphy’s framework proposed a six-step process for applying activity theory to design a constructivist learning environments. Since this study was focused on evaluating an existing learning environment, modifications to the approach were necessary to provide a more effective framework suitable to the
specific needs of this study. For example, the sequence of the steps was not suitable for the context of this study since the focus of this research was the VR learning environment, which was part of the activity structure. The activity structure of the learning environment section needed to be analysed in detail and the researcher was in the opinion that better and deeper analysis could be achieved if it was placed in step five. Therefore, a complete modified version of Jonassen and Rohrer-Murphy’s (1999) six-step approach that was utilised in this study is as follows:

1. Analyse the purpose of the activity system;
2. Analyse the activity system;
3. Analyse the tools and mediators;
4. Analyse the context;
5. Analyse the structure of the activity system; and
6. Analyse the activity system dynamics.

The following sections explain each of the above steps.

3.7.1.1 Step 1: Clarify Purpose of the Activity System

The first step is primarily concerned with the classification of the motives and goals of the activity system. This is the most important step where many techniques are appropriate including the analyses of formal and informal documentation, user observations, and interview process. The outcome of this stage will guide the construction of the problem. Sub-questions for step one are listed in Table 3.2.
Table 3.2

Sub-questions for Step 1

<table>
<thead>
<tr>
<th>Step One: Clarify the purpose of the activity system</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Understand the relevant context(s) within which activities occur</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1.2 Understand the subjects, and their motivations and interpretations of perceived contradictions in the system</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Note: Adapted from Jonassen & Rohrer-Murphy (1999).

3.7.1.2 Step 2: Analyse the Activity System

In step 2 the in-depth information about the components of the given activity such as the subject, object, community, rules, and division of labour is defined. The outcome of this stage will describe all aspects of the problem. Detailed information about the tasks, the requirements of the problem, the cognitive tools needed by the learner and identification of all other actors in the activity system is outlined here. Sub-questions for step 2 are listed in Table 3.3.
Table 3.3  

**Sub-questions for Step 2**

<table>
<thead>
<tr>
<th>Step Two: Analyse the activity system</th>
</tr>
</thead>
</table>
| 2.1 Define the subject | Who were the participants of the activity system?  
What were their roles? What was the expected outcome of the activity?  
What were the implied rules and roles of the members of the cohort of students? |
| 2.2 Define the relevant community-communities. | What were the implied rules and roles of the members of the cohort of students?  
What was the division of labour within the activity system? |
| 2.3 Define the object | What criteria were used to evaluate the quality of the outcome?  
How will completing the object move the participants towards fulfilling the aims of the course? |

*Note: Adapted from Jonassen & Rohrer-Murphy (1999).*

### 3.7.1.3 Step 3 Analyse the Tools and Mediators

Interaction among components of an activity system is mediated by tools and mediators which provide the direct and indirect communication between the objects. Analysis of mediators and their transformation over time will provide important information about how and why activity systems exist as they do. The outcome of this step will determine the kinds of models and methods that constraint the activity. Sub-questions for step 3 are listed in Table 3.4.
Table 3.4

Sub-questions for Step 3

<table>
<thead>
<tr>
<th>Step Three: Analyse Mediators</th>
</tr>
</thead>
</table>
| **3.1 Tool mediators and mediation** | What tools were used in the activity?  
|                                | What were the physical (VR computer, spreadsheets, etc.) and cognitive tools (decision-making models) were utilised in this activity? |
| **3.2 Rule mediators and mediation** | What formal and informal rules and assumptions guide the activities in which the participants engaged? |

Note: Adapted from Jonassen & Rohrer-Murphy (1999).

3.7.1.4 Step 4: Analyse the Context

Analysing the context is necessary for defining the overall activity system within which activity occurs and the dynamics that exist within and between the subject and the mediators. Activity theory is concerned with the context of an activity because little if any understanding will occur if the activity is analysed out of context. The outcome of this step will describe the problem context in the case being studied. This will also support the activity structure by identifying the tools, interactions and communication between the components. Sub-questions for step 4 are listed in Table 3.5.
Table 3.5

Sub-questions for Step 4.

<table>
<thead>
<tr>
<th>Step Four: Analyse the context</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Internal or subject-driven contextual bounds</td>
</tr>
<tr>
<td>4.2 Community-driven contextual bounds</td>
</tr>
</tbody>
</table>

Note: Adapted from Jonassen & Rohrer-Murphy (1999).

3.7.1.5  **Step 5: Analyse the Activity Structure**

Analysing the activity structure will reveal the hierarchy of activity, actions and operations. Activity structure describes the interrelationships of all the conscious and unconscious thinking and performances focused on the object. It is necessary to identify all of the actions and operations that support the activity. The outcome of this phase will be a detailed explanation of the activities, actions, and operations that are required to solve the problem. Sub-questions for step 5 are listed in Table 3.6.
Table 3.6

**Sub-questions for Step 5**

**Step Five: Analyse the activity structure**

<table>
<thead>
<tr>
<th>Sub-question</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Define the activity itself</td>
<td>In what activities did the subjects participate?</td>
</tr>
<tr>
<td></td>
<td>What chronological phases were there in the activity?</td>
</tr>
<tr>
<td>5.2 Decompose the activity into its component actions and operations</td>
<td>What actions were performed and by whom during each activity?</td>
</tr>
<tr>
<td></td>
<td>Who performed the actions?</td>
</tr>
</tbody>
</table>

*Note:* Adapted from Jonassen & Rohrer-Murphy (1999).

3.7.1.6  **Step 6: Analyse the Activity System Dynamics**

Step 6 is the final stage of activity analysis where the interaction and relationship between sub-systems are assessed. Each sub-system’s impact on the other is analysed to reveal the system dynamics. The outcome of this step is the linking of the sub-systems. The different parts need to be interconnected and the system functionality tested to determine if other resources are needed. Sub-questions for step 6 are listed in table 3.6.

Table 3.7

**Sub-questions for Step 6**

<table>
<thead>
<tr>
<th>Sub-question</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 What are the interrelationships that exist within the components of the system</td>
<td>What dynamics existed between the components of the activity system (i.e., the course)?</td>
</tr>
</tbody>
</table>

*Note:* Adapted from Jonassen & Rohrer-Murphy (1999).

However, for the purpose of this study, as stated before, some modifications to the original approach have been adopted. The order has been changed where step 3 has
been moved to step 5. A revised version of Jonassen and Rohrer-Murphy’s approach is given in table 3.8.

Table 3.8

*Adaptation of Jonassen and Rohrer-Murphy's approach*

<table>
<thead>
<tr>
<th>Jonassen &amp; Rohrer-Murphy’s (1999) Approach</th>
<th>Manifestation in this research</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Analyse the purpose of the activity system.</td>
<td>1) Analyse the purpose of the activity system.</td>
</tr>
<tr>
<td>2) Analyse the activity system.</td>
<td>2) Analyse the activity system.</td>
</tr>
<tr>
<td>3) <strong>Analyse the structure of the activity system.</strong></td>
<td>3) Analyse the tools and mediators.</td>
</tr>
<tr>
<td>4) Analyse the tools and mediators.</td>
<td>4) Analyse the contexts.</td>
</tr>
<tr>
<td>5) Analyse the contexts</td>
<td><strong>5) Analyse the structure of the activity system.</strong></td>
</tr>
<tr>
<td>6) Analyse the activity system dynamics.</td>
<td>6) Analyse the activity system dynamics.</td>
</tr>
</tbody>
</table>

*Note:* Adapted from Jonassen & Rohrer-Murphy (1999).

### 3.8 Limitations

Some limitations to the adaptation of Jonassen and Rohrer-Murphy’s (1999) approach were noted. The original aim for this approach was to design an activity system. However, in this research the approach has been utilised to evaluate an activity system. The researcher believes that the criteria provided by the framework as a guide in designing a constructivist learning environment can also be utilised in evaluating an activity system because of the similar criteria provided.

Chapters 4, 5, and 6 explore the results of the study.
Chapter 4: RESULTS

‘I cannot teach anybody anything, I can only make them think.’
- Socrates

4.1 Chapter Overview

As was stated in chapter 1, the overall aim of this study was to investigate through the lenses provided by activity theory (Engeström, 1987, 2001) how students’ interactions in a VR learning environment situated in the context of a business studies unit influence the learning of decision-making skills in crisis events.

The study had two broad foci: a within-activity system focus and a between-activity system focus. The within-activity system focus of the study is reflected in research question 1:

How do participants interact with the components of a VR learning environment situated within the context of a business studies unit that focuses on the development of decision-making skills in crisis events?

This chapter focuses on addressing research question 1 and thus has a within-activity system focus. The activity system investigated in this research study was a unit within the Bachelor of Business degree course at the university where the study was conducted: DM333 Marketing Decision-Making. The challenge in this study was to provide a description of the interactions of the individual, other people, and artefacts in fostering learning and teaching within the VR environment. Thus, this chapter explores the dynamics of the VR learning environments within this unit.
4.2 Analysis of VR Learning Environment

Emerging from the literature review in Chapter 2 was a theoretical framework (based on activity theory) incorporating a number of issues that impacted on teaching and learning in a VR environment. In this thesis the term VR environment refers to the holistic experience that students undergo in the theatre and includes interactions with peers, facilitator and the simulation. The VR simulation refers to the imagery depicted on the screen and in this case describes a factory in crisis. The VR software refers to the programming of the simulation. Highlighted in this framework are learning principles that emphasise collaboration, immersion, facilitation, and responsive/interactive scaffolding by teachers. The extent to which these factors impacted learning is explored in this chapter where evidence describing how each was manifested is presented.

Activity theory emphasises that internal activities cannot be understood if they are analysed separately in isolation from external activities, because there are mutual transformations between these two kinds of activities: internalisation and externalisation. Emphasis on social factors and on interaction between agents and their environments explains why the principle of tool mediation plays a central role within the approach. First of all, tools shape the way human beings interact with reality. And, according to the above principle of internalisation and externalisation, shaping external activities ultimately results in shaping internal ones. The VR sub-system was aimed at achieving the outcome through both processes of internalisation and externalisation.

The VR learning environment is itself a sub-system of the activity defined by the semester unit of study (DM333-Marketing Decision-Making). Figure 4.1 maps the activity system-based analysis of the VR learning environment sub-system. The tools in this sub-system were the VR simulated environment and the facilitator. The subjects were students manipulating the statistical models and the case study handout as objects in order to achieve the learning outcome, which is learning decision-making. This sub-system was constrained by the rules, the communities,
and the division of labour. The rules included a sense of responsibility for members of the class to participate and a sense of self-regulatory control over learning. The rules also included respect for each other, ability to exercise independent choices, acknowledging equitable participation, and being open. The communities were the classmates, the software developer, and the facilitator while division of labour among them included each member’s contribution to the discussion, the duty of the facilitator in guiding the discussion, and the software developer in navigating the environment. The level of activities involved in this environment were action; students discussed on what decisions to make in the crisis situation, and operation; students talked with each other in the group and they used the statistical model to arrive at decisions.

![Diagram](image)

**Figure 4.1.** VR environment sub-system.

The Jaboticaba Jam case study was first shown on the first day of class to students by their regular teacher and they were asked to solve the problems within 20 minutes, without being given any other information about the decision-making
theories. This was done as a guide to measure their knowledge in decision-making before the semester began. During Week 11, students were exposed to the same case study in the immersive VR environment at a commercial VR theatre. The task for students in this event was to decide on what action to take after the introduction of the crisis scenario. The task was not graded. The reader is reminded that the facilitator in this event was not the regular teacher but had been involved in developing the course and had piloted a VR session in the previous semester.

For this sub-system, the objects were the Excel® spreadsheet statistical model beamed on the left wall of the theatre and the case study handouts distributed during the briefing session while the subjects were the students.

According to activity theory, learning takes place when the subjects are engaged in constructing knowledge through mediated process. The activity systems are realised through tool-mediated actions by which actors collectively engage, enact and pursue an object. From the activity theory-based analysis of the VR learning environment, five major issues that impinged on student learning emerged: (1) student engagement, (2) cognitive challenge, (3) stimulation of prior knowledge, (4) the role of the facilitator, and (5) VR simulation as a tool. These issues are explored below.

4.2.1 Student Motivation/Active Engagement

Students were seen to be motivated and actively engaged in the VR environment when trying to solve the problem. An example where the group of students in the theatre were deeply engaged and collectively working together to solve the problem in the case study is evidenced in the following discussion right after there was a small fire in the factory:

Peter: Production supervisor
Facilitator: Production supervisor? (The facilitator clicked on the Production supervisor’s name and a statement saying, “He is on
the phone at the moment” appeared.) Ok, we tried him but the phone’s engaged, what do you think?

Amy: Is he on the phone with the production manager?

Facilitator: He’s on the phone with somebody right, probably with the production manager. Should we talk to the production worker?

Kim: Boy we might’ve been blown up wouldn’t we (laugh)

Facilitator: OK, you tell me what you want to do.

Dean: Go and have a walk down the factory...have a look

Facilitator: You (looking at other students) want to go and have a look at the factory, have a look and see what’s going on?

This conversation revealed how the students were engaged in the problem to try to find information about what was happening. They were co-constructing the learning environment with the help of the facilitator. This behaviour is consistent with Bereiter and Scardamalia (Bereiter, 2002; Bereiter & Scardamalia, 1996; Scardamalia, 2002) who argue that learners learn in an environment that emphasizes dynamic interaction. Another example of students engaged in the activity is as follows:

Facilitator: What are you going to do?

Bob: We must try to find appropriate ways to improve the situation.

Tom: Let’s try to make negotiations with them.

Renee: Yeah, like getting smaller size bottles so we actually can send the orders and say listen this is what’s available at the moment due to the shortage we would have put that in to make up the upset of production.

This conversation provides evidence that students were engaged in the problem and were working collaboratively making decisions as to how to inform the client about the crisis that had just happened. Constraint by the implied rules, they gave their opinions and respect others’ opinions. The classmates and the facilitator as the community provided the dynamic interaction in the environment while the software developer helped navigate the simulation to provide students with the exact view of the environment.
4.2.2 Cognitive Challenge

The VR environment provided cognitive challenges to learners through the facilitator. Activity theory is concerned with the role of technical and psychological tools as well as other human beings as tools. In this research, the activity system was reflected in the VR simulation and the facilitator who provided students with the cognitive challenges when solving the case study. As in the following conversation, students were challenged to use their cognitive skills in solving the problem. They used the statistical model and were trying to calculate the profit and loss arising out of the incident:

Facilitator: You’ve got some costing there on your sheet there, which I think you people are responsible for initially. We make 80% profit with 8.97 cents per unit.
Tom: We made $2.
John: You were making $2 before?
Tom: Yup
Facilitator: On the left hand side is the original costing, fixed costs and variable costs, total cost per unit is $5 and we are going to sell to this client for $7
Amy: Well can we reduce the fixed cost by not paying the factory?
Facilitator: They come as a service don’t they? So do you want to try this at point 8? 80%?
Bob: Ah! So that’s what he’s talking about. The break even price is $6.25 and the price you negotiate with the client is 7 bucks you are only going to make .75 cents on it.
Dean: Can we negotiate a little bit?
Facilitator: Yeah sure, what are you going to negotiate?
Dean: Cut costs
Bob: It’s not the usual product so I agree that we can cut costs here.
Dean: Very promising to earn $7 then come back to us and ask for a discount plus this stuff can earn a big margin not to worry anymore. 75% is a big margin.

The students were involved in a detailed discussion in using the statistical decision-making model in solving the situation. They were forced to use their cognitive skills and interpret the results of the statistical analysis. This behaviour is in line
with activity theory where learning is facilitated not only by using material tools, but cognitive tools as well (Engeström, 2001).

4.2.3 Stimulating Prior Knowledge

The VR environment provided an opportunity for students to apply prior knowledge. The following conversation shows students applying the theories of decision-making skills learnt throughout the semester during lectures and tutorials, in the VR case study. Students wanted to gather all necessary information even when there was not much time available.

Facilitator: The production manager says to contact the client. Should we contact the client?
Peter: I wouldn’t until I find out the exact information
John: Yes, but will you be able to get the information on time?
Peter: You can get some preliminary idea from the supervisor first.
Glenn: Probably give the client a call and just qualify his predicament. What are his needs, when does he need it, at the latest. I wonder how much flexibility we do have or we don’t have.
Glenn: If we don’t contact the client and the client finds out later on then, it could be a problem. If we do contact them, the problem will be solved.
Anne: May be talk to them and ask them what the issue, see what he’s got to say.
Glenn: And we should tell them the problem and know the full story of production. Just to see, just to confirm a few details with them and know what the exact dates are so you just double check with this person, how much response do you need that is critical. Go up front, until you know how to settle the bugs, you know, with the media.

These students were applying their knowledge of having to gather necessary knowledge first before making decisions. They were also seen weighing the pros and cons of their decision which was another feature that they learnt in their previous lectures (DM333 lecture, August 2, 2004). During lectures, the performance of a situational analysis was emphasised by the teacher. Gathering information was one of the first steps in the problem solving strategy as indicated
in the student lecture (DM333 lecture, August 2, 2004). Getting responses from the top level management in a “real-life” crisis scenario helped students gauge the importance of balancing the effect of their decisions on the organisation’s needs and the client’s demands.

Another conversation reflects the same situation just discussed. In this discussion students were articulating the need to get “some info on price.” These utterances occurred in a number of instances indicating that students were applying recently learnt knowledge:

Facilitator:  Let’s just see what the client has to say. It’s hard to get good clients these days.
Joe:  I think we should give them free instant delivery to make up with the loss.
John: Can we fill the order? Up to 80% and continue negotiating on price?
Peter:  So we need some info on price, we need some info on delivery.
Dean:  We need to know exactly how much production is spilt on the floor and how much is left.
Glenn:  I think we should talk to the production manager.
Dean:  Dispatch, so we can find the quantity that they have.

Students were collectively gathering information to help them decide on what action to take next. Being part of the crisis situation, students felt they were responsible for the incident and they were being careful when deciding what to do.

4.2.4 The Role of the Facilitator

The evidence suggests that the facilitator played an essential role in this particular VR environment. According to activity theory, the role played by the facilitator is important in enhancing learning. Figure 4.2 is an interpretation of a sub-system with the facilitator as the tool who moderated between the subject and the object to achieve the outcome.
Figure 4.2. The facilitator as a moderator in the sub-system.

The function of the facilitator was to (a) clarify the purpose of the scenario (guide), (b) supported students to focus on the end goal (provocateur), (c) moderated the interactivity with the simulation (moderator), and (d) coordinated the sequencing and timing of the events in the scenario (conductor). Figure 4.3 shows the facilitator giving a briefing before the VR session began.
As an agent to set the context and clarify the purpose of the scenario, the facilitator acted as a tour guide introducing the students to the factory and explaining the layout and operation of the equipment. At the beginning of the VR environment, the facilitator acted as a tour guide in the VR simulated factory:

Facilitator: Directly in front of us we’ve got the area where the bottles come through and you can see that there are sterilising cabinets at the front there, so the bottles can be sterilised the machine virtually directly in front of you now is a bottling machine and I must say it’s not operating at the moment but we’ve got, it normally spins and the bottles go on to it, it spins around and they’re filled with the jam. And that jam then as you can see from here it goes out to the station and through to the packaging area on the far side.

Here he was reinforcing the VR factory process by explaining the steps in the jam process to students. His role helped students to focus on the scenario without having to think of the whole process. This guidance was especially important for students who had never experienced a factory environment before.
The facilitator also provided information on the operation processes in the factory as is evidenced below:

Facilitator: So that’s the bottling machine and as we come around here normally that operating machine swirling around filling those bottles at a thousand bottles an hour and as we come across here just look to the left you can see there’s a section there that shows where conclude the bottles and into the packing room.

So that’s pretty much the operation, fairly simple operation not too difficult to follow that operation. So that’s straight ahead where the fruits come in up and over to the boilers across to the filling station and then across the outer packaging and through the wrapping machine and off to despatch. Very straightforward operation!

Such information is crucial setting the scene for students before they understood the whole jam producing process.

The facilitator’s role in scaffolding learning was evident in the follow-up survey provided to students after the completion of the VR environment. His explanation helped students to understand the running of the machine in processing the fruits into jam as is clear from the data in Table 4.1.

Table 4.1

*Students’ responses relating to facilitator*

<table>
<thead>
<tr>
<th>Question No.</th>
<th>% answered Agree or Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. The facilitator helped me to understand the simulation.</td>
<td>100%</td>
</tr>
<tr>
<td>10. The information in the simulation was clearly presented by the facilitator.</td>
<td>80%</td>
</tr>
</tbody>
</table>

*Note: From data of this research.*

The facilitator’s second function was supporting students to reach the end goal (provocateur), the facilitator advised students of the resources available to them in
the particular scenario. In doing that, he reminded students about the consequences of their decisions:

Facilitator: What we’ve actually organised is, unfortunately we can’t show them on the screen in front of you, we’ve got some contact with staff. If you have a look over on the left hand side, we’ve got a screen that shows us who you can contact, now with this, there’s obviously some problems here and well, it looks like a factory problem doesn’t it? What marketers need to know about this type of factory problem? Maybe we should think about that a little while. We do know that this is that special order of yours, which you’ve negotiated with your clients so I guess your reputation is on the line to some extent. So, what’s the situation, what do you need to know at the moment.

Through this combination of instruction and out-loud thinking on the part of the facilitator students were reminded that their role as marketers was important and the decisions they made could affect their reputation.

The facilitator provided clues and hints which helped students to solve the situation. This approach which is consistent with strategies adopted by Collins, Brown and Holum (1991) described as cognitive apprenticeship. As one student pointed out when asked about the importance of the facilitator:

Tang: He gives some hints for you to consider the situation but I just think in the real world, there’s no hints to consider like the guide will ask you, which people are you going to ask and you’re going to ask, there’s some hints with regard to hints differing in the real world. We don’t know. It’s a good practice for you to realise how to make decisions more exactly and to help you to solve the situation.

Here Tang agreed that the facilitator enhanced their understanding of the situation by giving some suggestions, which was not available in the real world. Tang also agreed that these suggestions were needed when learning decision-making process. In this situation, the facilitator is providing the modelling and scaffolding to help learners become immersed in the dynamics and processes of making decisions.
under pressure. He is in one sense helping novices (Lave & Wenger, 1991) or peripheral participants (Wenger, 1998) to become members of a community whose common thread is practice of decision-making under pressure. The facilitator models the discourses of business management and helps novices to attend to important events or phenomena in a simulation which purports to represent reality. Figure 4.4 shows the facilitator in action giving suggestions while referring to the screen images.

![Figure 4.4. The facilitator guiding the discussion.](image)

The third function of the facilitator was as a moderator who managed the interactivity between the students and the simulation. He encouraged students to engage in decision-making by asking questions and helped access the simulation based on students’ requests. He would signal the software developer to intervene as appropriate.

In the conversation reported below, the facilitator asked open-ended and close-ended questions to students. Students were seen talking to each other trying to find
out who to contact. Sensing this, the facilitator asked students who might be the best person to contact:

Peter: Production supervisor
Facilitator: Production supervisor? (The facilitator clicked on the Production supervisor’s name and a statement saying, “he is on the phone at the moment” appeared.) Ok, we tried him but the phone’s engaged, what do you think?
Amy: Is he on the phone with the production manager?
Facilitator: He’s on the phone with somebody right, probably with the production manager. Should we talk to the production worker?
Kim: Boy we might’ve been blown up wouldn’t we (laugh)
Facilitator: OK, you tell me what you want to do.
Dean: Go and have a walk down the factory...have a look
Facilitator: You (looking at other students) want to go and have a look at the factory, have a look and see what’s going on?

As indicated in this dialogue, the facilitator gave students options as to what to do next. One student decided to have a walk in the factory and the facilitator agreed by reinforcing the idea to other students. He then guided the VR screen according to their requests. Clearly the facilitator was trying to guide the scenario for students.

The facilitator also gave some hints to students by reminding them about the available personnel for them to get information from. The reminder prompted students to think carefully when trying to solve the jam supply problem. The spilt jam cannot be replaced in time due to the difficulty of getting the supply of the authentic Jaboticaba fruit. With the Christmas season approaching, the company must decide how to fill the orders coming from the clients’ customers. At this stage, students were not sure what to do even though they were briefed before exposure to the VR environment. The facilitator helped clarify the situation and reminded them what to do next:

Facilitator: Who might be the best person to contact? Over on the left hand side on the screen there, you can see the people that we could contact. Don’t be afraid to just rearrange your chairs or anything
ok, you might want to talk to one another about this and swing around because production manager, production supervisor who is actually down on the factory floor, the production worker is on the line, the product line, the packing room, which is this room you can see here in front of you, and the dispatch area where the finished product will go to the client. Who do you think were the best person to come to?

In this communication, he was providing instructions to students such as their seating arrangement before beginning the discussion. He also mentioned a list of available management personnel for them to contact to find information. After his introduction, students began to shift their seating positions and started talking to each other trying to figure out who should be the best person to contact. Figure 4.5 is an example of the discussion in the VR theatre.

Figure 4.5. Discussion in the VR theatre.

In the focus group discussion held after the VR environment session, students thought the facilitator assisted the communication with various personnel in the VR environment:
Interviewer: How does the virtual reality contribute to your understanding of the model?

Anne: You don’t have to go read and complete the operations manual, O.K. in the case of A, on the floor emergency or disaster, this person is your first point of contact. Second point contact with this person, third point, this person. If you want to find out how much stock you have waiting to be despatched, you contact the delivery, you don’t go to the packing area, you go to despatch. If they don’t know, you go back to the packing area. So you have the facilitator to help you do that, you can do it that way.

Interviewer: What role did, say, the facilitator play in that scenario?

John: It’s good for a little bit of guidance like obviously that was our first time in there.

Tom: He went in there and said, ‘this is how it works because…’ and he helped to explain the situation.

Andy: He is someone, an operator saying, we’d like to go here now. We’d like to go into the packing area. We’d like to see the packing machine or whatever. And he helped us.

In this situation, students agreed that it is important for the facilitator to be there to give guidance and to help them understand the situation.

The facilitator’s final role as a conductor was coordinating the sequencing and timing of the events in the scenario. As a conductor, he instructed the software developer to go from one point to the other. Then he stopped and pointed to the source of the problem. The conversation below started when the facilitator was showing students around the factory when he stopped at the spilt jam area:

Facilitator: Should we talk to somebody? This is actually the clean room here. It’s a separate, isolated part of the factory obviously got to be that way because we deal with crude stuff and that’s part of a hazard problem. Who do you want to talk to now?

Glenn: Try the production manager.

Facilitator: Try the production manager? OK we already know all that huh!

Tom: Can we go back up through there?

Facilitator: (Signalled to the software developer to navigate the software) as requested by Tom).

John: Make sure that’s been isolated. That we don’t need it anymore. And talk to the line worker.
Facilitator: The production worker? You can stay there for a moment. Ok, what he’s saying is stay in here, the production supervisor will call you again shortly. So?

Amy: The worker?

Facilitator: The worker, OK, what’s he doing?

John: He’s creating jams.

Here the facilitator communicated to the software developer to stop the navigation when he found the source of the problem. He gave students suggestions, options, and important information that helped them to decide on their next action.

The facilitator also interacted with the software developer when navigating the VR scene. The software developer sat at the control panel at the back of the theatre and with instructions from the facilitator, helped make the VR experience smooth. At one point he requested the software developer to rewind the VR simulation so that he could better explain.

Peter: Can you show us where the office was in relation to the factory again, please?

Facilitator: Alex (software developer), can you please backtrack a bit, the part where the marketing office was?

Alex: Sure.

Their interaction impacted on the learning by making the VR simulation better understood by the students.

Figure 4-6 is the full view of the VR console situated at the back of the classroom. The software developer sat here and worked with the facilitator in ensuring a smooth navigation of the VR environment.
When timing the events, the facilitator gave information about a temporal event. At this point he signalled the software developer to pause and gave students some ideas about their future tasks while navigating around the factory:

Facilitator: Now noticed that your desk is there and in the next few weeks I think what I liked you to do is to put a budget together to get some decent computing equipment and actually get this office started out.

Students felt the responsibilities when informed about what was required of them. This is normal in a real life situation, therefore putting them in that perspective helped them realise their duties as a marketing executive. During the focus group session afterwards, students were asked about the impact of the VR environment and one student responded:
Kim: This is the closest encounter of the actual experience of what I expected being a marketing manager, not sitting there constantly reading books and reading and writing marketing plans but actually making the smaller decisions, especially in the VR environment. This one’s the one that’s got me closer to where I imagined I would be in marketing.

In this instance, Kim was confident with the experience and she felt as if she was responsible for making the smaller decisions in the VR environment. Her expectations of working as a marketing executive in the real world have been achieved through the VR simulation.

The integration of a set of tools in the VR environment contributed to the effectiveness of the VR environment. The set of tools such as the VR simulation, the ambience, the facilitator, the supplementary information and the coordinated interactivity combined in a synergistic fashion to improve the authenticity of the experience. The importance of the role of the facilitator enhanced students’ understanding during the learning process in the VR environment. His guidance helped students envision the problem in the factory and provided them with enough information to make decisions.

From the constructivist perspective, the involvement of external influences assists the learner in the learning process. Driver et al. (1994) argue that the facilitator must guide learners effectively in the learning process within a constructivist paradigm. The facilitator in this study was actively engaged in guiding students in the VR environment. Here, he was an external influence which helped students to learn and better understand the decision-making process in the VR environment. The facilitator’s behaviour was consistent with Vygotsky’s idea of scaffolding and the zone of proximal development. As an expert, he helped fill the “gap” in the students’ mind and helped them achieved greater understanding by moderating the learning experience (Vygotsky, 1978).
The facilitator was also involved in fostering a community of practice where he acted as an experienced member of the learning community sharing knowledge with newcomers (in this case, students). His communication with students has helped them to understand the process of decision-making thus making students an expert at the end of the lesson. This is consistent with Lave and Wenger’s (1991) idea of communities of practice.

Furthermore, the facilitator played an important role in promoting situated learning. According to Shell and Black (1997), learning occurs in a situation specific to what is learned. In this situation, the VR learning environment was a simulation of a factory environment where crisis occurred and students were exposed to the type of responses that could occur in a similar real life situation. The case study, moderated by the facilitator who is an expert in the field of decision-making, enhanced the situatedness of the learning experience.

The approach in teaching in the VR environment when analysed from activity theory’s point of view provided a different perspective. Activity theory focuses on the activity that the facilitator was engaged in while using the VR as a tool. He acted as a moderator in this environment while working with the object to achieve the learning outcome. His action when giving information, guiding students through the VR environment and motivating students was consistent with his role as a moderator.

4.2.5 VR simulation as a Tool

The impact of the VR simulation on the learning outcomes can be described in two ways: (a) the VR simulation has helped provide a visual presentation that is integral to the VR that provided enhanced learning opportunities; (b) the VR simulation enhanced the interactivity in the VR environment. Figure 4-7 depicts the VR simulation as a tool in the sub-system in supporting learning between the subject and the object to achieve the outcome.
Figure 4.7. VR simulation as a tool.

Firstly, the VR simulation provided a simulated visual presentation that enhanced learning opportunities. This reduced the working memory load by providing an environment enriched with stimuli. The VR simulation provided rich stimuli that helped enhance the learning process. As stated in chapter 2, the working memory load is lessened when information that uses both texts and visual lead to better understanding (Clark & Paivio, 1991). With limited capacity, the working memory load needs to be freed so it can focus on other more important tasks such as those that involve higher order thinking (Baddeley, 1997). Figure 4.8 is a sample of the VR simulation.
The argument above is supported by comments given by students in the focus group discussions. Students had just finished experiencing the VR environment when the focus group interview was held. Their responses to the interviewer’s question below support the claim that the VR simulation helped reduce the working memory load which allowed them to focus on the task at hand:

**Interviewer:** We’re here at QMI\(^1\) this morning and you’ve just been through a scenario where you’ve explored some problems in the management of a jam factory. Would someone like to talk very generally about what your impressions were about the virtual reality scenario? I guess things like realism, value, a sense of engagement. I did go in there myself and I listened to some of the conversations that were going on and people seemed to be focusing on the problem. The question is to what extent did the problem come alive because of the technology or whatever? Reaction?

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\(^1\) QMI is the name of the commercial organization that provided the VR theatre for this research.
Tom: That was an interesting sort of first hand. It’s now actually, instead of just having a question on a piece of paper that you’re involved with a bit more actually seeing something. You’ve sort of like a 3D thing that you can actually look at. It makes the job a bit more involved and easier because you don’t have to think about what a factory looks like. You just concentrate on the problem in that way. You’re more a part of it I suppose.

Amy: And it gives you more stimulation to work on the problems.

In this conversation, students agreed that the VR simulation helped them focus on the problem-solving task. Tom’s statement that “you felt you were part of the event” implies that he was able to integrate diverse stimuli about the physical structure of the factory holistically and yet had sufficient mental resources to engage with the problem. The simulation was interesting and helped them “see” the factory environment.

The VR simulation helped to enhance learning by providing visual aspect to the printed case study. Students acknowledged that many people are not able to visualise a business client’s requirements effectively. Therefore, with VR, they can construct a mental picture of the scenario:

Interviewer: Obviously if you’re making some renovation that’s variable, a kitchen for example, a client wants to know what you’re going to do, like if you’re just making huge boxes all the time. A kitchen is just a mix of modules. It’s very modulated.

Joe: A lot of people can’t visualise, you can’t say I’ll have this table with that. That’s why they’ve got those little paint tins that you can go home and put on the wall, because people can’t picture what it’s going to look like so VR is good for that sort of thing. It helps them to see what the real thing will look like and they can then coordinate easily.

Here Joe agreed that VR was a good way to help people who cannot visualise a hypothetical situation. He gave an example of the use of VR that helped ease the working memory load, thus making it able to do other thinking processes focusing on solving the problems efficiently.
The effectiveness of the VR simulation as a tool that reflects the real world is reflected in the following students’ responses in the focus group session:

Anne: It’s a good way to visualise how thing are set out without having to go through the cost of actually building or whatever you’ve got to do.

Tom: It’s good because you can interact with it as well.

In this conversation, students were positive that VR environment has the potential to provide real life simulation. They were immersed in the simulated problem in its context, thus minimise the need to visualise it from reading text. Students could interact in the VR environment.

More examples where the visual aspect of the VR simulation helped release students’ working memory load can be seen from the answers they gave in the focus group interview below. The interviewer was asking students for reason why they were enrolled in the unit:

Interviewer: So it’s part of the course. What about yourself?

John: Number one is probably to finish this subject to do something else but getting into it, it does help to understand, yes you can use models, but also sometimes models might be effective. You can make decisions, based on models, but the model has to be supportive of a lot of situations. It’s finding out which models are more suited to the content.

Interviewer: So the models we’re talking about are on the spread sheet models.

Glenn: Yes. In that way you can put some things on paper but won’t be as helpful. It’s really helpful because at some degree, people have been saying, this is progression analysis. We won’t actually go through it or anything. And this is how you do it. While we’re learning it, how are we going to do it if we don’t get an example to practise it and actually see how it works and see? This VR environment does that, wow!

Peter: Some of this would be good as a starting point because you actually knew what you were doing. Every other subject you seem to pick up some elements but here, everything is going this way and you get to focus on the problems without having to think of the scenario.
In the above transaction, Glenn was happy that the VR simulation provided them an “example” to practise and see how it actually works. Meanwhile, Peter agreed that the VR environment provided the factory environment for him thus helped him focused on the tasks.

The VR simulation also provided an effective learning experience. Students were able to understand better what was learnt in the lectures and tutorial. Students were taught the theories of decision-making in lectures and tutorials throughout the semester and they had to apply their knowledge when solving the problems in the VR environment. Towards the end of the focus group interview, students were asked about the effectiveness of the incorporation of the VR in the unit. A typical response was:

Interviewer: We’re changing it now to a virtual world. By presenting a virtual world as part of this course this unit, has that helped the key objectives of this course which is decision-making?

Amy: This course, this subject has been very good in really putting the nuts and bolts behind decision-making processes and I came across some decision trees, and the VR, it just took me off into a completely different area that I’ve never even thought about. I thought it was something really basic.

Joe: With the VR, it makes you think more in depth than the written case.

The above conversation shows that students thought the incorporation of the VR simulation gave them deeper understanding of the case study. It also assisted them in understanding the decision models learnt during lectures and tutorials. Figure 4.9 shows the focus group discussion held immediately after the VR session.
Figure 4.9. Focus group session held after the VR experience.

More positive responses came from students when the interviewer asked about the contribution of VR to their understanding:

   Interviewer:  How does the virtual reality contribute to your understanding of the model?

   Anne: I think as an undergraduate subject, it’s important because most people in this degree have just been looking at the flow charts or reading through text saying this is how the factory works. I guess it just depends on the level of experience. Some students may never have (sic) walked through a factory and so it’s critical and really helps people orientate themselves. Some people have and they know what it’s all about, so it’s probably less of a help to them.

   Peter: If you’ve come straight from school to uni and you haven’t been anywhere and experienced decisions like that before.

   Bob: Or seeing inside a factory it’s sometimes like you never expected and this helps us to orientate ourselves in the factory, like it was real.

Here Anne felt the VR experience was useful because it provided students with a visual aspect of a factory. Previous experience had some form of different influences on the learning experience. Bob on the other hand thought that the
reality of the VR experience helped him to orientate himself in the factory environment.

According to constructivist principles, knowledge is built on prior experiences. If experience of a factory is absent then students are disadvantaged because they need to construct a hypothetical factory from diverse and possibly secondary experiences (i.e. from readings, pictures or peripheral experiences such as film). What appears to happen here in this session is those students are provided with a common vignette of a factory. They have a shared experience and all, therefore, have a common foundation to construct understanding. However, even though some students might have richer experiences nevertheless this VR simulation provides a common framework.

The function of the VR environment as an effective tool in moderating the learning process by providing real world simulation was also evidenced in the following conversation from the focus group interview. A majority of students were positive about the VR simulation. Some positive responses are as follows:

Interviewer: What do you think of the VR scenario, has it helped you in understanding decision-making models?

Amy: I have never been so grateful to be part of an (VR) experience. It was amazing to experience something I have longed to put into practice. Instead of reading a text case study, I can experience a situation that would soon be part of my future world. I loved the session.

Ling: My experience with the VR was positive. I found I identified with it as a learning tool. I feel that as a group we attained better decisions than if I went through the process individually. I could really understand the benefits of VR with complex situations or decision-making as a tool for helping marketing management. Apart from teaching it could be an important crisis management tool.

John: This is the closest to real life I experienced through the actual experience of what I expected being a marketing manager, not sitting there constantly reading books and reading and writing marketing plans but actually making the smaller decisions. This ones the one that’s got me closer to where I imagined I would be in marketing.
Bob: It made me realise a couple of things which I didn’t realise along the course but it made me aware that, although there are situation that may arise, it depends on where you’re working and in a situation like that when there’s an explosion, there are decisions that you need to make and how do you go about making those decisions is important, not like just running to one person or running to another person but in terms of having the system whereby people know what to do and what should be done. So it does help in terms of decision for that particular instance.

From the above responses, students were satisfied that the VR environment gave them real world experience, provided the interactivity with their peers in solving the problem and made them realise the importance of making decisions in crisis presented situation. These criteria provided by the VR environment enhanced their learning.

Finally, the interactivity provided as part of the VR simulation was an effective attribute of the VR environment. Pre-prepared responses from various levels of management were made available as part of the VR simulation and was beamed on the side screen in the VR theatre. Students were involved and actively engaged in the VR environment. Their contribution to the discussion in the theatre was lively and they were concerned with the outcome of the situation if proper decision was not made. The example below reflects how concerned students were when trying to find out ways to solve the problem:

Facilitator: Well that’s as much as we know right, so, important order do you think?

Tom: Very important, verrry important (phone ringing).

Facilitator: Ahah! That call from the Production Manager (students read phone conversation on the screen). What are you going to do now?

Tom: Call him straight away.

John: No, no, confirm that we can have 80% first.

Bob: Yeah, I would call him and tell him what the problem is.

Tom: 80% of the product is spoiled I must say, don’t know, not sure and that’s his fault (referring to the Production Manager).

Joe: I think we should see how long before the order can be filled.
Bob: They have to be notified that there is a problem of some nature.
Facilitator: There’s been a problem with the supply of this jam as you can see. After the spill, there’s only some amount that is not available, so if they use any of the available stuff as far as the total volume is concerned, we’re still ok.
Tom: Can’t be! There’s not much that’s gone anyway, if that’s all we have.

In this transaction, students were arguing extensively about whether they should inform the Production Manager or not about the problem. The facilitator helped them interact with the Production Manager by clicking on the response from him. Students’ interaction with the facilitator helped them advance in the discussion. They were concerned about the effect of the jam spill and the facilitator was there to help them get the manager’s response. Their conversation and interaction with the facilitator showed that they were engaged in the problem solving.

According to constructivist point of view, active engagement in the learning environment has a significant impact on learning (Bereiter & Scardamalia, 1996). Students’ dynamic interaction in this situation helped them clarify the situation and understand the problem better.

Despite the positive experiences recorded above, there were limitations to the visual aspect of this study that is concerned with the concept of suspension of disbelief. That is, students did not see the simulation as convincing and hence they were not inclined to suspend belief sufficiently to engage in the scenario. A small number of students who had VR experience elsewhere and have had exposure to 3D games technology exhibited a negative perception of the VR simulation. In the conversation below, students were questioning the quality and the expensive cost of VR despite lack of quality in the simulation:

Interviewer: What do you think of the VR scenario, has it helped you in understanding decision-making models?
Bob: Small businesses could buy a projector for $1500 these days and probably be much the same as the expensive VR.
Joe: You could pay four actors to do the job, $1500 each where it would cost you a million bucks to set that thing up for exactly the same scenario.

John: Those little belts that went from one room to the other, like the facilitator said oh, you can see it coming from the other room and I’m like, what’s he talking about? The pipes he said, that go across, I’m like, what’s he talking about? And then in the air, they have a picture going across so there was kind of gaps in it like, if you hadn’t been to that factory, you couldn’t really visualise it properly because you couldn’t see all the parts.

And in another conversation towards the end of the focus group discussion, students were comparing their experience with a high quality VR environment to the one used for this research:

Interviewer: What were your expectations right at the beginning? You knew you were coming out here and would have a little bit of a trailer before hand about what virtual reality is about. Did you have any expectations built up?

Tom: I’ve been on a course where I’ve seen it once so compared to the other one this VR simulation was pretty basic. The other one you were much highly involved so if you’ve seen those ones and then coming back to that sort of instruction it had, whereas with the other one it was more engaging.

Bob: I’ve experienced the police one.

Interviewer: Have you?

Bob: In that one, you can have this person here on this intersection and all that kind of stuff so it was probably a large step back but this VR has potential to grow.

John: Yeah! And seeing everyone walking around, I’m pretty impressed with that one.

Bob: There are people lying on the ground. O.K. We’ve had an explosion here. The glass was severed. Everyone gets up, walks around. You could actually walk into the production manager’s office and sit there, unlike this one.

In these transactions, lack of suspension of disbelief in this environment indicates that students were selective in what tools they engaged in facilitating learning. Herrington and Herrington (2006) argue that it is important for suspension of disbelief for students to feel immersed in the learning environment. In this study, previous exposure to 3D technology including high quality game technology resulted in students comparing the game technology with the VR learning
environment. It is harder to suspend disbelief if the subjects appear fake, thus there is lack of immersive feeling in the environment. Clearly, if they are aware that there are better resources they are reluctant to apply poorer quality materials. The verisimilitude of the simulation is clearly an important factor and one that needs to be addressed as students become more technologically sophisticated.

Although some students questioned the quality of the simulation, they nevertheless benefited through the experience. The visual aspect even though did not match with what they have experienced, it enhanced their learning. The following response was from one of the students who scored high on the ICT experience. He responded when asked about the quality of the simulation:

Interviewer: What were your expectations right at the beginning? You knew you were coming out here and would have a little bit of a trailer before hand about what virtual reality is about. Did you have any expectations built up?
Tom: I’ve been on a course where I’ve seen it once so compared to the other one this VR simulation was pretty basic. The other one you were much highly involved so if you’ve seen those ones and then coming back to that sort of instruction it had, whereas with the other one it was more engaging.

In this conversation, Tom was comparing his own experience with a “better” 3D simulation before whereas the VR simulation in this study was very basic where he felt it was not engaging. However, in another conversation observed and recorded during the discussion in the VR theatre, Tom seemed to be too involved in the discussion of the case study. Lack of “reality” in the VR simulation did not seemed to affect his engagement:

Facilitator: Well that’s as much as we know right, so, important order do you think?
Tom: Very important, verrry important (phone ringing).
Facilitator: Ahah! That call from the Production Manager (students read phone conversation on the screen). What are you going to do now?
Tom: Call him straight away.
John: No, no, confirm that we can have 80% first.
Bob: Yeah, I would call him and tell him what the problem is.
Tom: 80% of the product is spoiled I must say, don’t know, not sure and that’s his fault (referring to the Production Manager).
Joe: I think we should see how long before the order can be filled.
Bob: They have to be notified that there is a problem of some nature.
Facilitator: There’s been a problem with the supply of this jam as you can see. After the spill, there’s only some amount that is not available, so if they use any of the available stuff as far as the total volume is concerned, we’re still ok.
Tom: Can’t be! There’s not much that’s gone anyway, if that’s all we have.

From the conversation above, Tom was seen as very aggressive in arguing his position. Even though he was sceptical with the quality of the VR simulation, his active involvement in the VR environment did not reflect that he was affected with the quality of the VR simulation.

Real life simulation provided by the VR technology in this study contributed to the overall authenticity of the learning environment. Even though a selected few were not impressed with the quality of the VR simulation, quality did not have a tremendous affect on their learning. Students felt the VR environment gave them a whole new perspective in university learning.

In line with activity theory, the role of tools as moderators is strongly reflected from the discussion above. The VR simulation was seen as an effective tool to facilitate learning in providing real world experience. Learning in a real world environment is consistent with the idea of authentic learning environment as proposed by Herrington et al. (2003). They argue that learning is enhanced when learners are exposed to learning environments that resemble the real life, workplace situation. Similar to this is the idea of situated learning where learners learn from the environment surrounding them. Lave and Wenger (1991) argue that learning in these situations can be easily understood. Having a common framework
4.3 Conclusion

In response to Research question 1 the findings appears to show that the VR environment provided an effective learning environment within itself. This supports previous research by Byrne (1996) whose findings support the idea that students exposed to VR treatment did significantly better than those who did not. In particular, evidence is presented that showed how students engaged as a community of learners in solving the problem presented in the simulation. There is evidence that the task was cognitively challenging and required the stimulation of prior knowledge. Furthermore, the findings emphasise the pivotal role of the facilitator and the authenticity provided by the VR simulation. The VR environment helped to link all of the other parts of the sub-systems into a blended learning environment that was “authentic.” This issue is returned to in later chapters.

Herrington and Oliver (1997) highlighted the performance of experts and models in situated multimedia although in this study the expert has been a live facilitator. The success of the VR relied on students collaborating and acting on presented information, by developing hypotheses and solution plans in teams. Although hints and prompts can be embedded in programs, teachers are necessary to closely monitor student use and understanding of situation, and provide additional support when needed. As was proven in the results of studies done by Dalgarno (2004) and Johnson et al. (1998) where the role of facilitators in the VR environment is necessary to enhance learning. Authentic learning environment provided by the VR simulation supported the idea that VR can be a powerful tool in enhancing learning (Bricken, 1991; Dede et al., 1999). This type of environment is capable to provide significant affordances to enrich learners’ learning compared to traditional learning (Fletcher, Hawley, & Piele, 1990; Khalili & Shashaani, 1994).
For a wholesome effective learning experience to occur, the connection between the VR environment and other teaching/learning approaches involved in the teaching of the unit should be explored. For this reason, research question 2 is focused on the interrelationship between the VR environment and other types of teaching/learning events in the unit, namely lectures and tutorials, online learning, and industry panel presentation. The dynamics of the interrelationships between these different teaching/learning events were explored and investigated to discover the role VR environment played in achieving the learning outcome. Jonassen and Rohrer-Murphy’s (1999) six-step approach to activity theory in a constructivist learning environment was applied in unravelling the interactions.
Chapter 5: COMPREHENSIVE ANALYSIS OF THE UNIT as an ACTIVITY SYSTEM

‘The knowledge of anything, since all things have causes, is not acquired or complete unless it is known by its causes.’
- Avicenna

5.1 Chapter Overview

The overall aim of this study was to investigate through the lenses provided by activity theory (Engeström, 1987, 2001) how students’ interactions in a VR learning environment situated in the context of a business studies unit influence the learning of decision-making skills in crisis events. The study had two broad foci: a within-activity system focus and a between-activity system focus. The between-activity system focus of the study is reflected in research question 2:

What relationships exist between virtual reality learning environment and other components of a unit of study that focuses on the development of decision-making skills in crisis events?

The activity system investigated in this research study was a unit within the Bachelor of Business degree course at the university where the study was conducted: DM333 Marketing Decision-Making. A major challenge in this study was not only to provide a description of the interactions of the individual, other people, and artefacts in fostering learning and teaching within the VR environment (Research Question 1 as reported in Chapter 4), but also to provide a description of interactions between the VR environment and the other teaching/learning events (or sub-systems) within the DM333 unit. Thus research question 2 specifically seeks to understand how VR complemented other teaching events that students experienced during the semester. In other words, given an activity system such as a VR environment does not occur in a vacuum, it was important to understand the
network of activity systems that went to define the unit DM333 as an activity system.

This chapter focuses on addressing research question 2 and thus explores the dynamics of the between-systems interactions of the VR environment with the other three teaching/learning events within the unit. In section 5.2, the findings of the analysis of the overall learning environment are presented. In the concluding section of this chapter (section 5.3), the findings presented in section 5.2 are synthesised to present a global view of the overall activity system.

5.2 Analysis of overall learning environment

An adaptation of Jonassen and Rohrer-Murphy’s (1999) six-step approach for analysing activity systems such as constructivist learning environments (described in chapter 3) was utilised to analyse the overall learning system (DM333 – Marketing Decision-Making) and its component sub-systems. The modified version of this framework has the following six steps:

Step 1: Analyse the purpose of the activity system
Step 2: Analyse the activity system
Step 3: Analyse the tools and mediators
Step 4: Analyse the context
Step 5: Analyse the structure of the activity system
Step 6: Analyse the activity system dynamics.

Each the following six sub-sections reports on each of the six steps in the analysis in turn.
5.2.1 Step 1: Purpose of the Activity System

The activity system being investigated in this study (DM333 – Marketing Decision-Making) is an elective unit of study within a Bachelor of Business degree. Students graduating from this course will pursue careers as Marketing Executives. The elective unit provides students with opportunities to learn the skills and knowledge to become effective decision-makers in a Marketing Context. The rationale presented to students for participating in the unit was given in the unit outline as:

This unit provides you with an opportunity to advance your marketing knowledge and skills beyond fundamental concepts gained in other units, by building skills in marketing decision-making.

The teacher in charge of the unit articulated his belief about the purpose of the course as:

I am teaching them to learn the skills of marketing decision-making so they can apply these skills when they go out to work. At the same time I am using different decision-making models, qualitative and quantitative, including the virtual reality simulation to enhance the learning aspect.

The purpose of the activity system being investigated (DM333 – Marketing Decision-Making) thus can be summarised as being to facilitate learning about marketing decision-making models and their applications in “real-world” business contexts. Activity theory provides a useful model for bringing together a wide range of information about the factors that impact on the activity. Figure 5.1 outlines the components of the overall activity system.
Figure 5.1. Components of the overall activity system.

The participants in this activity were students, the teacher, the facilitator and the software developer. The subjects in this activity system were the students whose motivations nominally were to learn decision-making skills, pass the unit, graduate and get a good job. However, during the focus group interviews, it was found that the major motivation of many of the students seemed to be just to pass the unit. Thus it seems that there were differences between the outcomes of the unit as stated in the unit outline and the outcomes desired by a majority of the students (12 out of 18 students). The unit outline described the outcomes as:

1. To provide you with theoretical and application skills in marketing decision-making;
2. To build analytical and decision-making competence through the application of contemporary computer programs such as spreadsheets and databases; and
3. To provide flexibility in both delivery and learning environment to aid comprehension and capability.
This contradiction is evident from the observational and the focus group interview data. This extrinsic level of motivation is exemplified by the following discourse derived from a focus interview:

Interviewer: What are you trying to achieve in this course, this unit? What’s your objective enrolled in this unit?

Joe: Take the unit off the requirement list. Take out the subject off the course list.

Kim: I think each unit is another aspect to our course that we have to take.

Peter: Number one is probably, to finish this subject and do something else but getting into it, it does help to understand.

Susan: I only did it because I thought it was going to be one of the easy subjects.

The discrepancy in the stated purposes and desired outcomes between students and the unit introduces a dimension that both challenges and constrains the activity system. Motivations influence the alacrity with which students engage in learning activities. Students are predisposed to question the purpose of each activity and engage to the extent that that activity is perceived to address their needs (Sansone & Harackiewicz, 2000).

This section explored the purpose of the overall activity system. Components of the activity system were identified and the subjects’ motivation was explained. The contradiction between the teacher’s and the learners’ intent in teaching and learning the unit was regarded as a necessity by activity theory (Nardi, 1996b).

In the next section, the unit DM333 (Marketing Decision-Making) is analysed as a complex activity system in terms of needs, tasks and outcomes.
5.2.2 Step 2: Analysis of the Activity System

According to Jonassen and Rohrer Murphy (1999), activities are driven and motivated by needs; activities happen in order to satisfy needs. The tasks in an activity are designed in such a way to achieve the needs.

The components of the overall activity system being investigated supported the students in the process of learning decision-making. The outcome was to be able to apply these skills to real-life situations. Details about the components of the overall activity system are explored below. Here, the focus is on the subject, object, and relevant communities.

The subjects within the overall activity system were 2nd and 3rd year university students studying Marketing Decision-Making (DM333) who were doing a Bachelors degree in Business at a large technology-based university in Australia. Their roles as designated in the unit outline were to study and understand the lecture notes and to do the tasks assigned to them by the teacher. The expected outcome of this activity was for them to be able to apply the decision-making theories to the real world problems after they had graduated.

The structure, objectives, implementation strategies of the unit were described in the unit outline prepared by the teacher and approved by the University. The timeframe prescribed for the unit was 13 weeks or one semester (refer Appendix B). The sequencing of teaching and assessment items in the unit outline were governed by principles laid down by the University.

The outcome of the unit was evaluated by three assessment tasks:

- Online discussion forum;
- A written report and the presentation; and
- Final examination.
These assessments were evaluated based on the following criteria:

- Ability to show deep understanding of the different decision-making models;
- Ability to analyse logically the different decision-making models and their use in the case studies; and
- Ability to apply the correct decision-making models in the final examination.

The prime actors within the activity system were the students. Other actors in the activity system were the teacher, the facilitator, and the software developer. Students’ roles were to conform to the university’s code of conduct, to attend class, and to engage in the various learning activities such as accessing the unit’s website for discussion forums, read notices, and to join in class discussions.

There were formal and informal rules governing the activity system. The formal rules were those outlined by the University in the Manuals of Policies and Procedures (M OPP) available on the University’s website. These rules must be adhered to by the teacher, students and the facilitator while informal rules dictated the relationship between the students, students and teacher and teacher and the facilitator.

The following are examples of the formal rules taken from the unit outline:

**Student Rules and Assessment Procedures**

Students are responsible for both knowing and abiding by all rules relating to assessment, academic dishonesty, non-discriminatory language, conduct and performance as contained in the University Manual of Policies of Procedures and the Student Charter. Details of these rules and policies, how they will be applied in this and other units, guidelines to assist you in understanding them, as well as penalties for non compliance, can be found via the Rules and Polices link on the Online Learning and Teaching Site for this unit.

Informal rules that involved the interaction between students and students, between students, and teacher and between teacher, student and the unit were partly shaped by the students’ social background. There were tacit rules as well. For example
students adopted practices and behaved in ways governed by their cultural heritage. There were expectations of what students do and did not do in a class which were influenced by both explicit rules of engagement and cultural and personal rules. Their upbringing moulded their behaviour in class. There were 15 Australian students and 3 Asian students from India and Hong Kong. The behaviours of Australian male students were very different from those of the Asian students. The Australian students were very outspoken and confident when giving their opinions in class, as well as in the online discussion forum. They were also very active in the VR environment discussions as opposed to their Asian counterparts. Their behaviour is consistent with activity theory’s perception that the communities shape and influence learners’ behaviour in the process of learning (Kaptelinin, 1992; Kuutti, 1996).

The teacher as part of the community had the authority to direct and assign students to the tasks involved in the process of learning. Students conformed to the teacher’s instructions in order to maximise their chances of getting a fair grade and passing the unit. This behaviour is consistent with activity theory’s assumption that the rules influence the way learners behave in a learning environment. This collective activity and division of labour resulted in learning that was prescribed by the physical structures of the unit and its delivery.

Activity theory is concerned with consciousness. Vygotsky (1978) stated that consciousness is constructed through a subject’s interactions with the world and is an attribute of the relationship between subject and object. In this activity, students were conscious about getting involved in different activities that led to learning decision-making. They were also conscious that they had to learn how to apply these theories to the cases during tutorials as mentioned by the teacher during the first day of lecture:

Teacher: During tutorials in this unit, you will actually be involved in problem based learning and if you work collectively you will come up with different ideas to solve the case studies. You will need to use the theories learnt during lecture to help you solve the case studies.
The division of labour as part of the community was outlined by the University in both the unit outline and in the University’s Manual of Policies and Procedures (MOPP). Students were required to finish all assigned work in and out of class in a timely manner. The teacher was responsible for the running of the lectures/tutorials and marking students, assignments. The facilitator together with the software developer was responsible for operating the VR environment.

There were some constraints and affordances of the culture, community and rules. Students enrolled in the course were constrained by the rules and regulations governing the units they enrolled in, the class timetable and the learning processes in each unit. The teacher, as a staff member of the University, was obligated to follow instructions as described in the University’s MOPP and the unit outline. Table 5.1 outlines the division of labour.

Table 5.1

*Division of labour*

<table>
<thead>
<tr>
<th>Component</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>Completing assignments, contributing to group work for group presentation, study for the final examination</td>
</tr>
<tr>
<td>Teacher</td>
<td>Providing the outline approved by the university, marking the assignments, teaching the class, providing consultation time</td>
</tr>
<tr>
<td>Facilitator</td>
<td>Providing guided VR simulation</td>
</tr>
<tr>
<td>Software developer</td>
<td>Developing the VR software with guidance from the teacher and software developer</td>
</tr>
<tr>
<td>University</td>
<td>Providing the resources and infrastructure described in the unit’s official outline. In meeting responsibilities of equity and propriety it states rules for students to follow such as plagiarism, assignments submission and final exam attendance. It sets standards for performance and monitors the achievement of students emphasising a curriculum built around “real world” scenarios.</td>
</tr>
</tbody>
</table>

*Note:* From this research.

In this section, the unit has been analysed as an activity system. Various events, actions and tools can be mapped as part of an activity directed towards learning.
Step 3 looks at the analysis of the tools and mediators in the overall activity system.

5.2.3 Step 3: Analysis of the tools and mediators

In activity theory, tools are one of the most important components. Tools mediate the relationships between the subject and the object and thus foster the accumulation and transmission of social knowledge. Tool use influences the nature of external behaviour and also the mental functioning of individuals. Tool mediation is an important source of socialisation as is formal education.

Tools are not restricted to concrete objects but include people, language and materials (Engeström, 2001; Kuutti 1996). The tools available in this learning environment were the teacher, the facilitator, the peers, the case study tasks, the online discussion forum, the industry panel members, and the VR environment. Each of these tools played a mediatory role in supporting student learning about decision-making. As explained in chapter 3, the teacher incorporated these tools when preparing the instructional design for the unit. It was envisaged that each tool would help students to achieve the outcome of the activity which was to facilitate learning decision-making. Engagement with each of these tools constituted an activity system in its own right.

In order to understand better the role these tools played in mediating the learning about decision-making, the tools were classified into two categories: Human/Mind Tools and Technical Tools. These were further divided into sub-categories of synchronous and asynchronous tools. The categories and sub-categories of tools are depicted in Figure 5.2.
For human/mind tools, the synchronous tools were the teacher, the facilitator and the industry panel members while the asynchronous tools were the decision-making models, namely the qualitative models and quantitative models represented through the VR simulation. For technical tools, the synchronous tools were online discussion forums and desktop computers while asynchronous tools were VR simulation and the PowerPoint® software. The following sub-sections explore each of these categories of tools in more depth.

### 5.2.3.1 Human/Mind Tools

**Synchronous Tools**

*Figure 5.3. Synchronous tools.*

*Lectures/tutorials.* The lectures/tutorials mediated the development of the students’ understanding about decision-making. Within this learning environment, there existed other tools such as teacher/facilitator and their peers (Figure 5.3). The following two sub-sections explore the role of the teacher/facilitator and peers in the lectures/tutorials.
Teacher/Facilitator. This section explores data emerging from the study that supports the proposition that the teacher was an effective tool in mediating learning about decision-making in marketing. Transcripts from the episodes that follow show how the teacher was an effective tool in mediating learning:

1) Asking key questions with follow-up; and

2) Giving real-life examples.

Asking key questions with follow-up is illustrated in the following vignette where the teacher was lecturing on qualitative decision-making models. Here the teacher had just finished talking about Cognition and Judgment in qualitative decision-making. He started off by asking the following question to students:

Teacher: Somebody tell me about the meaning of cognition and judgment in qualitative decision-making.

John: Does it have to do with thinking about the consequences of your decisions?

Teacher: Not quite. OK, who stayed up late for the Olympics Opening last night?

Tom: I did

Renee: It was too late. I had lots of assignments to do.

Teacher: Listen to yourselves. Your decision to watch or not to watch was actually a good example of cognition and judgment. This is an important part of qualitative decision-making.

In the above situation, the teacher was gauging students understanding by asking a specific question about decision-making. His explanation by referral to specific examples from students’ recent experiences helped increase students’ knowledge about decision-making.

Giving real-life examples is illustrated in the following vignette from one of the tutorials. At the end of lecture in Week 2, the teacher had just finished lecturing on quantitative decision-making models. He asked the students for questions to help them clarify their understanding:
Teacher: Do you have any questions so far?
Glenn: I still don’t understand last week’s lecture on CRM2 and the database model. Can you explain further?
Teacher: Well, let me give you an example, what is going to be the next popular car?
Glenn: Ferrari?
Teacher: How to determine this?
Glenn: I still don’t understand.
Teacher: OK, let’s look at another example. The Treasury Casino knows what the customers’ wants and needs are, so they plan their business according to what each customer’s spending habits are. This is CRM. And the Casino keeps a database of all its customers. That’s how they keep track of the customers’ habits.
Glenn: So you mean to say a company must keep a collection of consumers information at all times?
Teacher: That’s right!

Here the teacher used two real life examples in order to facilitate Glenn’s understanding of CRM. When the first example did not facilitate understanding, he went onto another example. This type of activity was utilised quite often by the teacher not only in tutorials but also at the end of lectures.

The facilitator acted as the moderator in the VR environment. His role was to navigate the simulated scenario and guide the discussions in the VR environment. Detailed analysis of the facilitator’s role was covered in discussion on research question 1 (see section 4.2.1).

The facilitator introduced the VR simulation to students and guided them in the process. His role was evident in the following conversation. He was showing students around the simulated factory and familiarising them with the jam manufacturing process in the factory:

Facilitator: Over here on the back wall straight ahead of us, those brown cardboard cartons there, some jams that’s already been finished,

---

2 CRM: Customer Relations Management
I can tell you that the factory today is actually working on this particular special product that you organise as part of the accounts and a little bit more to the right, there’s quite a bit of product here that’s been finished, and in through the wall over here, is the entrance to the despatch area, so the products is, when it’s completed is wrapped, advertised and so forth and taken out through here to the despatch area, and you can see there’s quite a lot of product sitting in here as well. That’s previous production some other jams and things that we’ve been producing, such as your common marmalades and so forth, so that’s probably far enough from here, I think.

During this vignette, the facilitator explained the process and showed them around the factory. His guidance was consistent with activity theory where the role of facilitator is to facilitate a better understanding of the situation. His behaviour is consistent with Vygotsky’s (1978) concept of zone of proximal development where scaffolding is one of the effective strategies to access the zone of proximal development.

**Peers.** Learning from peers as moderators helped students to understand better from the point of view of someone else. It was observed that the language used was not complicated and it seemed that the students felt at ease asking questions to their peers instead of to their teacher. This behaviour is consistent with Jonassen’s (1995) assumption of “active” learners who participate and interact with the surrounding environment in order to create their own understanding of the subject. Also, most constructivists view learning as a social process that involves external influences, in this case their peers.

Two different types of learning emanated from peers: enabling learning and knowledge-building. Enabling learning occurred when students helped their peers to navigate and understand how to utilise the technical tools. In contrast, knowledge-building occurred when the students advanced their knowledge and understanding about decision-making.
An example of enabling learning occurred in one of the tutorial sessions when the students were asked to access the online website to read the case study. The following conversation between Anne and another student was heard during this tutorial. They were trying to access the statistical model needed to solve the case study.

Anne: The instruction on the website is not complete. Do you know how to get the program up and running?
Glenn: Yeah, I think you have to go here (pointing at the screen) to access it.
Anne: You’re right, I got it now. Thanks.

Here Anne was using her peer to help her get access to the knowledge. Her action provided her with a way to access the technology. Without access to the technology, she would not be able to proceed with the learning. Anne was frustrated with the incomplete instruction on the website, because time was not spent on doing the tasks. However, with help from her peer, she managed to access the program quickly and was able to continue with the tasks. Therefore, it is important to get help at this stage even though it was not part of knowledge building. This is a necessary, but not sufficient condition to enable knowledge building.

Consistent with activity theory, peers as an emerging tool helped moderate the learning process in this situation. Anne was using her peer as a tool to facilitate her understanding of the process before actually doing the required tasks.

An example of knowledge-building occurred in this vignette. The students were heard discussing with their group members the quantitative decision-making model they had to use to solve the case study. One of them wanted an explanation from his friend:

Bob: I don’t get it. Which model do we have to use, the regression analysis or the database? And how do we use it?
Tom: The thing is, you must look at the purpose of your analysis. Like, if you want to find the profit, then use the regression analysis.

Bob: So, what then after I got the numbers?

Tom: You use the figures to base your decisions on. Easy.

Here Bob was confused with both the decision-making models and Tom helped explain these models to him by differentiating the different purposes of the different models.

In both the cases of enabling and knowledge-building learning, the peers, as part of the community, supported each others’ learning helped to mediate understanding.

**Industry panel members.** The role of industry panel members in shaping students’ understanding was critical. Their 15 years experience in the industry helped give a “real-life” point of view that enhanced students’ understanding of the decision-making theories. They were also involved in the enabling and knowledge building process of learning. This is evident through the industry panel members’ feedback to the students on their presentations.

An example of knowledge building is evident during the presentation of one of the groups where the second panel member was quite impressed with the whole presentation. However he wanted more information to be included in the written report:

Panel member 2: I’m quite impressed with your presentation, did you give any thought to include in your written presentation what your overview of the models is and your complete work so all members can focus on that.

Anne: What we actually included (in the written report) was the checklist and the frequently asked questions because that’s what we thought were important. I can see where you’re coming from and I fully understand that. I think we will take your suggestion and update the written report.
Here the panel member noticed the difference in the presentation and the written report which he had read. He commented that the written report was incomplete compared to the presentation and suggested to the students that they provide a complete written report. The panel member’s guidance was similar to the idea of scaffolding in maximising the students’ understanding.

The feedback has made the group rethink about the content of their report. They agreed to take on the criticism from the panel member. The consequences of this feedback were that the group reviewed the written report before the final submission two weeks later. This is another example of the importance of support from the industry panel members as part of the community. They effectively shaped students’ understanding by facilitating the refining of their written reports.

Another example of knowledge-building was obvious from the following vignette. Students’ understanding of the decision-making models was further enhanced by criticism from the panel member:

Panel member 3: Can I ask you a question about your BCG3 analysis, am I correct to understand that you said it’s not relevant and you can’t tell us very much?

Renee: It depends on obviously the industry and the company specifically because what it’s saying from lots of reading today is that old models are not as relevant because companies are moving towards more unrelated units, sorry towards more related units and it (the BCG model) was made in the 60s where they were more unrelated units then, therefore, if you were deleting a unit you won’t be affecting any other units whereas today, according to the research the companies are moving towards that.

Panel member 3: Can you explain to me about your understanding? You talked about mainly the frames and related and unrelated units.

Renee: Yeah, ones that are related that affect each other’s sales, so it means that if it has an impact on each other’s sales

\(^3\) BCG – Boston Consulting Group – name of a model
that means it is not doing very well but customers associate it and it’s going to affect it but if you want to equate it to the car industry you could still do the same like in the motorcycle industry and electronics, these two are quite unrelated, so you could use it in that scenario. The same issues that have lots of segmentation and really strong branding and all these sorts of stuff and other full on all the time and they kind of related, so this car industry has so many categories.

Panel member 3: I disagree with you on this one. I think you need to understand how to adapt the analysis to your organisation. I think the BCG model suits your organisation very well. Give it a try.

Renee: Alright, I’ll take note on that one.

Knowledge-building was evident in the above vignette where critics from a panel member were noted.

**Asynchronous**

![Asynchronous tool](image)

*Figure 5.4. Asynchronous tool.*

**Decision-making models.** Qualitative and quantitative decision-making models are cognitive tools used by marketing professionals to aid in making decisions (Figure 5.4). In this unit, the students were introduced to 8-10 different decision-making models. These models were used by the students in their written reports, in solving the case studies during tutorial sessions, and during the VR environment. These models helped students predict the outcome of decisions made and action to take for different parties involved.
For example, during the decision-making discussions in the VR environment, a quantitative decision-making model was used to facilitate solving the problem of fulfilling the client’s order:

Facilitator: What about the cost per unit losses?
Anne: At 50% supplies for $6.50 the unit price we’re listing was number 9 plus which has gone down to $8.72, which is still not too bad and we still make a profit of about 25% and that would still cover up the amount of losses.

Facilitator: Cost at $7 and the previous amount was $8.11 now we’re on 50% so $8.11 and it has dropped down to 6, $8.72.
Anne: Yes, that’s about 40% or so am I right?
Facilitator: Yup, you’ll be looking at $8.11.
Anne: Yes.

Anne was using the quantitative model to help her decide on the best price to charge the client. Her judgment was based on the estimated cost and profit and was enhanced through the use of the quantitative model. Here the use of models as tools helped students achieve the outcome of understanding the use of the decision-making models.

5.2.3.2 Technical Tools

Figure 5.5. Synchronous tool.

Synchronous

Online Discussion Forums. Students contributed to the online discussion forums by giving responses to the preamble posted by the teacher and receiving feedback from their peers. This synchronous process involving the use of technology as a
tool is depicted in Figure 5.5. The process of arguing by agreeing or disagreeing to the ideas given by their peers involved deep thinking and reasoning.

The example below occurred when a group of students contributed to the topic of VR as a decision-making tool. In their discussion, they debated on the topic “Virtual Reality: The most accurate model.” They used the online discussion forums as a medium to interact with each other to increase their knowledge about decision-making models:

Renee: It is imperative that marketers are able to make the best decisions possible as they normally involve large investments to help the company grow in some way. One particular decision that marketers often must make is that related to New Product Development. One superior model that has been designed for this as well as a number of non-market related problems are Virtual Reality which has proven to be a very useful decision-making tool. While it does have three minor limitations these are easily overcome they include; difficulty in finding the right package and setting it up, this can be solved by hiring companies who specialise in this area, often costly, (especially if you include hiring a consultant to the price of the programme), however, accuracy of program and on-going use justifies the cost, further the cost is constantly going down as the technological superiority for a standard PC application increases and finally it is only really applicable to decisions related to new product design/use and new system implementation, however, these are major on-going decisions from most companies and, therefore, maintains its relevance.

Virtual Reality has a number of features which show forth its accuracy and relevance as a decision-making tool, these include; it can be designed with extensive detail so it limits the real situation), many levels of detail may be added, can be made to scale to assist the accuracy of determining sizes of products/objects in real life and where they need adjustment, can be easily edited/up-dated to keep it relevant, (Theirauf, 1995). Visual and audio senses can be tested via VR as well as elements such as weight and gravity (Mahoney and Computer Graphics world, 1996).

Yet the best aspects of a VR programme as stated by Mahoney and Computer Graphics World, (1996) and Taylor (1997) is the sense of interactivity and immersiveness, increasing the application to the real world context without having to incur the costs of developing a real model of the product/system that is being tested. Further, the ability to access VR technology at a much cheaper cost through ones own PC at the same high
performance level increases access by bringing more businesses to the technology (Mahoney and Computer Graphics world, 1996).

Hence, I believe that this is the most accurate model designed so far, especially considering the ease in altering a particular scenario reduces the chances of the technology becoming outdated. Furthermore, cost is justified and it’s easy to use once it is set up reduces management’s fear of adopting the model.


Tom: In terms of decision-making, I do agree that Virtual reality would be the most accurate model. However, despite all the advantages of VR, it does have some drawbacks. According to an article by Dr. Piet A.M. Kommers, the disadvantages of VR include: extremely expensive, the graphics can be cartoonish and blurry, and there is still a slight, but perceptible time lag between the user’s movements or commands and their translation in Cyberspace. The equipment some users must wear, such as headgear, gloves, and other devices, needs refinement. At this early stage in the development of VR, no one knows what the long the long-term effect of using head-mounted displays might be on human eyes or what the possible psychological effect might be from spending too much time in Cyberspace. People using VR head gear sometimes complain about chronic fatigue, a lack of initiative, drowsiness, irritability, or nausea after interacting with a virtual environment for a long time. We do not know how much each of these symptoms depends on the characteristics of the VR systems themselves, or on the characteristics of the individuals using the systems.


Anne: I am not sure if I agree that VR is the most accurate mode. However, I do agree that virtual reality has improved over the years, and is being used in New Product Development, creating opportunities for marketers to test concepts with customers. Virtual prototypes as described by Crawford and Benedetto (2004), come in the form of static pictures, video clips that simulate a product into action or presented to respondents over the internet. This provides the ability to drive a new product like for example a model car in a virtual environment. It creates opportunities for the marketer, to observe possible consumer
behaviour scenarios in terms of interest to purchase product, insights, experience, perspectives that can assist to access success or failure and thereby make decisions according to market needs. The popularity of virtual communities has shifted the power from producers/managers of goods and services to consumers who buy them. Hagel and Armstrong (2000) states that virtual business models provides a distinctive focus that generates information/data from which can be used to support decisions that might affect future outcome. Understanding the perceptions and needs of a customer who is likely to make a purchase can reduce perceived risks. Managers can then decide to narrow their target and make decisions either about the product or packaging to satisfy the niche market.


John: In response to the comments of Anne in relation to the existence of a contingency plan in counteracting a low selling period, I agree that a plan of such should be on hand. However, I fail to see the need of a model for any unexpected circumstance, as external environmental data should already be “fed” into an existing model designed to determine the approach to low sales levels. Likewise, there is little relevance of the stated example relating to the effects of terrorism/SARS on airline industry demand. Surely every business contemplates a time (either permanent or temporary) where its product(s), in this case an airline, become undesirable to consumers. In these circumstances, it is the marketer’s role to engage the MIS, which should be designed to allow such data, in repositioning the market offering –here, in a manner that downplays any contemplated threats associated with terrorism/SARS, whilst emphasising security measures of counteracting. Further, lobbying of industry bodies and governmental departments to sway public opinion can follow. A model is not required for all decisions, just as a model isn’t needed to evaluate another model – if it was, where would you draw the line?

“Oh, we’ll now need a model to evaluate the effectiveness of the models that currently evaluate all the original models that are in place to assess our profits.”

That is the targets for profits of a business relative to actual performance will by themselves judge a model’s effectiveness. Here’s a practical example of my point regarding readjustment: if a manager’s car breaks down on the way to work, he/she doesn’t panic because of lack of a “model” – he/she engages their brain in rethinking their entire strategy of getting to work. His/her relative success in arriving at work by his targeted time will be indicative of the success of his choice in itself. This illustrates the point raised above, and is also held by Mitchell (1999) p 187 who states that “good models of perceived risk can
only really be judged on what the researcher is attempting to achieve by designing the model.” Therefore, data exists in readily accessible form to evaluate most models without the need to implement yet another costly monitoring tool.


Ling: I do agree that new product development has been benefited from virtual reality in recent years. Virtual Reality is becoming more popular nowadays and is used in design and engineering process to simulate products before they are actually made. Errors and mistakes during the development process can be fixed at once before it goes any further, thus it reduces the cost of production. Proposed design will then be sent around the world on the Internet for review and modification at different sites before production begins. DaimlerChrysler (DC) opened a new Virtual Reality Centre at its Mercedes-Benz passenger car development centre in Sindelfingen, Germany. After only a few months of operation, this supercomputer-driven visualisation facility proved so useful that the members of DC’s executive strategy board now approve designs using virtual images instead of physical properties. (Don, 2001).

On the other hand, virtual reality does provide an opportunity for decision-makers and consumers to preview or have a virtual experience of a newly designed product. For example, Mercedes adopted the VR technology into its Powerwall which is a 23-by-8-foot screen showing a “virtual Mercedes C320” to the visitors. When it’s not entertaining visitors, the Powerwall serves as the portal to car designers, fluid-dynamics engineers and ergonomics experts collaborate to solve problems well before the physical prototype stage. (Don, 2001).


In this example, students were debating the benefits and limitations of Virtual Reality as a decision-making tool. Tom agreed with Renee that VR was the most accurate model for decision-making, however, Tom stressed the fact that VR has some disadvantages. On the other hand, Anne had doubts about VR being the most accurate model but she agreed with Renee that VR is useful. John used an analogy to stress his point that there is no use of models in unexpected situations. Ling agreed with Renee on the importance of VR. He gave several examples to illustrate his point.
These students were not only agreeing or disagreeing, but they also supported their opinions by quoting reliable sources as required by the teacher to strengthen their points. Without face-to-face interaction, students were able to voice their opinions openly. In the vignette above, even an Asian student who was very quiet in class seemed to give a good feedback in contrast to his non-contribution at all in class discussions.

This application of knowledge was a good example of how the online discussion forum was an effective tool in enhancing their understanding. The nature of the online discussion forums where face-to-face interaction was not available, made students feel comfortable arguing among themselves. This characteristic has been one of the strengths of online learning especially for students who were shy to speak up in class.

Asynchronous

Asynchronous tools.

*Figure 5.6. Asynchronous tools.*

**VR simulation.** The VR simulation was a simulation of a real food canning factory and represented one asynchronous use of technology as a tool (Figure 5.6). Responses to the crisis scenario from various level of management were prepared beforehand in the form of phone replies that was screened on the side wall. This simulation was effective in providing real-life experiences to students. Here the use of the simulation as a tool was effective where students felt they were really part of the scenario. According to Dede et al. (1999), a VR simulation has the ability to enhance students’ conceptualisation and integration of complex ideas. VR simulation was also important in learning situations where observations of internal
workings are important to aid understanding. These features of VR were indeed capitalised in this research.

The conversation below reflects how concerned students were in the environment. The facilitator was at the end of the discussion in trying to solve case study problem. At this stage, no concrete decision had been made as to what to do with the limited supplies available for the clients. Renee was deeply involved in the discussion from the beginning and here is the ending of the discussion:

Facilitator: Just when you thought it was safe to get back into the water, the problem is here again. Now you can see what’s happening, see where it is at the back door and everybody’s going home and past the special order, and it’s a type of jam you have here. It looks to me like the office staff has been closing it. (referring to the VR screen). So it’s an evolving situation isn’t it? Perhaps you haven’t even got that 50% supply of raw jam.

Renee: Why don’t we just close down?
Facilitator: Pardon?
Renee: I said I think we just need to close down?
Facilitator: That could be a problem, we have to make a profit to pay you people and you’ve just joined us and at a pretty high salary too, I might admit.

Renee was frustrated with the ending of the discussion and suggested that the factory be closed down. Her reaction can be interpreted as her being very involved in the situation as a result of the immersive quality of the VR simulation.

The role of tools in activity theory is to moderate learning. Here is an example where the VR simulation has effectively immersed students in the situation. Her learning was enhanced through the VR simulation in line with the concept of VR learning environment was said to be as equally effective as real life (Bricken, 1991).
The effectiveness of the VR environment was also reflected in the responses from the focus group discussion below, when asked about their opinion of the VR session:

Bob: That was the greatest visual experience I have ever had.
Joe: I thought maybe the idea of the layout actually gave you more of an idea of the situation where, you’ve got a list of people but you’ve also got an idea of where they were in relation to the problem and how the despatch and packing, not so much involved, the production manager, and you can actually see where they were in relation to the problem and how they can counter what’s going on and how they’re involved. That helps you in that the factory is already there for you, all you need to do is just concentrate on the task.

In this situation, the student liked the idea of putting everything in context in relation to the factory and the management personnel. The VR simulation provided a good representation of a complex scenario in a way that conventional teaching methods are not able to do. This is one of the reasons for the effectiveness of VR in education.

*PowerPoint® software.* Use of PowerPoint® software during presentation to industry panel helped students deliver the presentation professionally (See Figure 5.6). From classroom observation, the general knowledge they had on PowerPoint® software was shared among the group. This was done throughout the semester when they were preparing for the presentation. Using the PowerPoint® software managed to relay their message effectively. However, wrong usage of the PowerPoint® failed to get the message across as in the following conversation with one of the panel members during the industry panel presentation in Week 12:

Panel member 1: The sans serif fonts that you used are very hard to read because they tend to run on and is not easy to read. I can’t see a thing on the screen!
Tom: Yeah, I’m responsible for that. I didn’t realise that before. Now I can see what you mean.
Panel member 2: I suggest next time you use contrasting colours. For example black fonts on white background or yellow fonts on blue background. It makes it much more easier on the eyes.

Tom: Yeah, I’ll remember that next time, thank you.

From the discussion above, the use of tools as mediators of the learning process fit in with activity theory’s assumptions in this research. Two categories of tools, technical and human/mind tools complement each other in shaping learning. Synchronous tools allowed interaction with the people in the surrounding environment through enabling learning and knowledge-building. These interactions helped clarify students’ understandings which consecutively support the learning process. Synchronous tools helped shape the mental process of learning.

Alternatively, asynchronous tools, supported learning by providing the means to problem solving. These tools were used as equipment to accomplish the goals of learning.

In conclusion, the technical tools should be introduced at the beginning of the semester. This would effectively orientate students to the availability of the tools so that they could use throughout the semester to achieve the learning goals. Brief exposure on the use of the technical tools could further benefit students. The quality of the technical tools, especially the VR simulation could be upgraded to allow maximum benefit for all students.

The human/mind tools, especially the decision-making models could be better applied to case studies if enough time was given to familiarise themselves with the models and concepts. Introduction of tools as mediators should be carefully planned not only to achieve the learning goals, but also to allow the ease of use among learners.
5.2.4 Step 4: Analysis of the Context

Activity theory assumes that individuals’ actions are influenced by their socio-cultural context and, therefore, cannot be understood independently of it (Engeström, 2001). Events in the surrounding world influence the learning process and influence the effectiveness of the activity system. Participants or actors depend on each other for goals to be achieved, tasks to be performed, and resources to be furnished. Activity theory provides a framework to focus on key aspects of the context, gives fresh insights about the phenomena observed, and also describes the social activities in a structured way (Kaptelinin, 1996, 2003; Nardi, 1996a). In this section, the practices occurring in the course through different strategies and components are considered for the part they play in an activity system. The aim is to establish the focus and relevance of each sub-system and how these contribute to the overall development of the course as an activity system.

According to Dey (2001), context is defined as any information that can be used to characterise the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves. This definition extends previous definitions of context as simply an environment or a situation (Salber, Dey, & Abowd, 1999; Ward, Jones, & Hopper, 1997). For the purpose of this research, context is defined as a situation where an interaction of learners with their surrounding learning environment where the activities occur. Figure 5.7 describes how the setting for this research can be considered to comprise both internal and external activities related to contexts. Internal contexts consist of learner’s intention and teacher’s intention which provide the focus and relevance of the activity. The external contexts consist of physical environment, technology and social connection.
According to activity theory, the nature or structure of a context is drawn from any information that can be used to characterise the situation or circumstances in which an event occurs. When dealing with different situations, context is the key element used to infer possible actions and information needs.

Activity theory differentiates between internal and external activities (Figure 5.7). It emphasises that internal activities cannot be understood if they are analysed separately from external activities, because they transform into each other. The following analysis focuses on the internal and external situations.

5.2.4.1 Internal Contexts

Participants in the course came from many backgrounds but by engaging in the unit they established a common goal. Figure 5.8 outlines the internal contexts.
The key motivation of the majority of the students enrolled in this unit was to pass the unit and further advance towards completion of their degree. In the learning context, students were the subject with a common goal of learning decision-making and passing the unit. As mentioned in Section 5.2.1, the following conversation during the focus group interview reflects their internal intention:

Interviewer: What are you trying to achieve in this course, this unit? What’s your objective enrolled in this unit?
Joe: Take the unit off the requirement list. Take out the subject off the course list.
Kim: I think each unit is another aspect to our course that we have to take.
Peter: Number one is probably, to finish this subject and do something else but getting into it, it does help to understand.
Susan: I only did it because I thought it was going to be one of the easy subjects.

According to activity theory, learners consciously create context involving specific goals. Here the students were creating their own set of context by having their own specific goal of passing the unit. This internal intention reveals that there was a sense of common goal among students when they were able to accept the content of DM333 as part of the degree requirement.

This orientation was in marked contrast to the teacher’s intent which clearly was to induct his students into the community of marketing decision-making practice. His orientation was exemplified by the comment he made during an interview conducted with him at the beginning of the semester:

I am teaching them to learn the skills of marketing decision-making so they can apply these skills when they go out to work. At the same time I am using different decision-making models, qualitative and quantitative, including the virtual reality simulation to enhance the learning aspect.

Here the teacher is “tooling up” the context to enable students to achieve the creation of a context in which active engagement with resources to solve problems
is a defining attribute. The teacher perceives himself as a facilitator of learning. The text suggests he sees the content in the form of software computer models and the VR as opportunities to engage students in learning. His focus is on learning skills and hence she contributes to the context by consciously contributing an expectation that students will engage with the resources.

In summary, the internal context is action oriented. The essential aspects of the context are the notion of relevance and focus for individual participants. The context is relevant in that students are goal directed and see value in the outcomes. There is meaningful engagement by students who, in terms of activity theory, are the subjects, with the context which represents the object. The context is focused as is evident in both the descriptions of teacher and students. Student engagement in this instance is in line with activity theory’s concept that emphasises on human activity that can only be understood within its sociocultural and historical context.

5.2.4.1 External Contexts

Externalisation is important when interactions among actors (students and teacher) require their activities to be performed externally in order to be coordinated. That is, whereas the internal context is typified by the relationships related to individual achievements, the external context provides opportunities for action to incorporate multiple players. Figure 5.9 outlines the external contexts.

![Figure 5.9. External contexts.](image)

The external contexts are divided into physical environment where the learning occurs, social context where relationships and interactions with people surrounding
the learners are analysed and technological context where the role of technology is investigated in the learning process. These contexts are analysed for the affordances or barriers in learning decision-making skills.

The physical environment. The four sub-systems provided four different physical contexts for the learning process. All the learning processes had one specific goal, to learn decision-making skills.

The first physical context, the lectures/tutorials was situated in a classroom and surrounding computer laboratory. These environments provided the necessary surroundings and resources that facilitate interactions and socialisation in the process of learning. Swivel chairs were provided to allow students to face the teacher or their peers during the lessons. The face-to-face setting allowed students to interact dynamically with the teacher and their peers in facilitating understanding. This process of learning in a social context is congruent with activity theory’s concept on the role of the surrounding environment that provides the social/cultural support that shapes the learning. The peers and teacher acted as tools in moderating learning and understanding. The role of the communities with assigned roles and rules helped learners achieve their intended outcomes.

The second physical context, the online discussion forum, was held virtually; there was no face-to-face interaction. However, students were required to respond to their peers and the teacher’s preamble and share their arguments and opinions together with justifications with their peers (compliance with the explicit “rules”). Their contribution was descriptive in the first online discussion forum. The discussion below comes from the first online discussion forum on Customer Relations Management (CRM).

Tom’s: Many companies are investing huge sums in CRM but are still getting bad results because of over-reliance on their part. Unfortunately also many companies are finding that CRM does not help much.
Ting: from the strategic perspective, CRM may potentially benefits for customers, retailers and suppliers.

According to Reedy, CRM is not a tool or a business tool. CRM is the result of a customer-oriented strategy.

John: I agree with you in that CRM is a result of a customer-oriented strategy.

Tom: I agree that CRM is increasingly significant within today’s business organisation.

It seemed that their primary intent at this stage was to submit just enough to the online discussion forum to get a pass mark. However, in the second online discussion forum, students were more alert because the teacher had reminded them about the low grades they received for the first preamble. Their concern for a higher grade was reflected in them engaging in much deeper discourse in the second discussion forum as opposed to the first one. This in turn helped them to be more focused on the discussion topic about learning decision-making in marketing. Even though their initial intent was to pass the task, it later led to deeper understanding of the theories and concepts.

In this context, students were able to select and explore particular issues related to their need to understand “decision-making”. The context provided again the opportunities for relevance and focus. The technology afforded opportunities for constructing a shared intellectual space or environment in which knowledge could be co-constructed. Interaction using technology in the online discussion forum had broken the linear flow of instruction, thus aiding the individualised learning process in a collective setting (Warschauer, 2004). Here activity theory’s principle of learners co-constructing knowledge in a shared environment was apparent.

The third physical context, the VR environment, was a large immersive commercial VR theatre. This environment was conducive to learning and teaching the case study because the physical space in the large, high-ceiling theatre with comfortable swivel chairs made students felt at ease. Students were able to position themselves in a face-to-face format during the discussion. The large, semi-spherical screen provided the immersive quality for the factory environment in the case
study. The simulation helped students experience a visualisation of the case study similar to that they would receive in a real factory. It also gave them a common point of reference and focus for the knowledge-building discourse. This was not possible if it was a printed case study where the interpretation depends on the individual experience. Figure 5.10 shows students were having discussion while the facilitator was guiding them in the VR environment.

![Figure 5.10. Discussion in the VR environment.](image)

The VR environment context provided students with the surrounding that was focused on the learning aspect. The relevance to the case study scenario provided in this context allowed students to share and experience learning while co-constructing the activity.

The fourth physical context was the industry panel presentation. This presentation in front of the experts in the field helped shape students’ understanding through their “live” feedback. In groups, students were required to respond to a case-study
and argue their strategies to a panel of expert business managers who had volunteered their time to participate. Students were confident interacting with the panel members because of the panel’s perceived credibility based on the more than 15 years experience most had, compared to the theories and concepts they learned in the classroom. The notion of historical learning is evident when the panel members used their experience in shaping the learning process. The panel members themselves, as part of the community helped shape students’ understandings by bringing the outside world situation to the learning process. This context supports the idea of communities of practice where interaction with experts in the field helped learners learn new activities (Wenger, 1998). They also brought the cultural norms of practice and discourse into the context as in many cases the panel members were insightful and cutting in their criticisms. Further discussion on industry panel presentation is discussed under Step 3 in Section 5.2.5.3

In conclusion, both the internal and the external contexts were relevant in informing and building the mental construct in achieving the outcome. This is consistent with activity’s theory concept that humans learn by doing and that human consciousness is formed by interaction with the external world (Kaptelinin, 1996).

5.2.5 Step 5: Analysis of the Activity Structure

In this step, the intent is to define the activity itself, by decomposing the activity into its component actions and operations. Actions are conscious, and different actions may be undertaken to meet the same goal. When actions are repeated, they automatically become operations (Nardi, 1996a).

There were several complex sub-systems (see section 3.6) involved in achieving the course aims. However, those sub-systems where the students represent the subject are the main focus here. These sub-systems were structured chronologically with the lectures/tutorials introduced at the beginning of the semester and continued throughout the semester followed by the online discussion forum held
during Week 4 and Week 10. Next was the VR intervention during Week 11 and finally, the industry panel presentation which was held during Week 12. The following four sub-systems involving students as the subject in this research are arranged in chronological order as follows:

- Lectures/tutorials;
- Online discussion forum;
- VR environment; and
- Industry panel presentation.

All tasks in the sub-systems were assessed except the VR environment. The criteria used to evaluate the quality of learning in each of these four assessment tasks were set by the teacher and made available on the unit’s website. The evaluation criteria for both the final examination and the group written report and presentation were mainly concerned with understanding of decision-making models and the ability to apply these models to the case studies given. While for individual contributions, assessment was based on the ability to respond to the preamble and to other students’ opinions using valid sources as references.

The purpose of the unit (DM333) was about learning decision-making using quantitative and qualitative models. Students learnt and applied these models to a series of case studies presented during lectures/tutorials. By completing the graded tasks in the sub-systems, students were expected to have learnt decision-making skills that would enable them to apply the skills in real world. The learning process involved is consistent with the course aims and the success of this purpose was judged by student performance in a formal assessment comprising end-of-semester examinations and graded activities.

In each of the sub-systems several tools were used to moderate the learning process. The following sections provide a brief analysis of each of these sub-systems. A deeper analysis is subsequently provided.
Lectures/tutorials: The lectures provided students with the theoretical frameworks and concepts underpinning decision-making while the tutorials provided them with opportunities to apply these theories. Case studies and decision-making models used in the tutorials represented real life situation and students were taught to solve the cases by using decision-making models, among which included the statistical models using database and spreadsheets. Through the application of case-study teaching approaches, students were exposed to the application of the decision-making theories and concepts. Similar to traditional cases, simulated cases are based on real business dilemmas. Unlike printed case studies, a simulated case study unleashes the power of audio and computer simulation to bring home the circumstances of the industrial setting (Harvard Business Online, 2006).

Online discussion forum: Activity theory assumes that learners are engaging in constructing knowledge and meaning through mediated processes such as online learning. This theory proposed that learning is a social, interactive, symbol-mediated process of construction of reality and that the activities are mediated by technical and psychological tools including other human beings (Leont’ev, 1989).

The online discussion forum in this unit gave freedom for students to express their thoughts and opinions over current issues in the marketing field. Guided by the preamble provided by the teacher, students were encouraged to contribute intellectually to the discussions. This form of knowledge delivery was different from the normal classroom lectures/tutorials in order to create interests among students and to make them felt at ease when giving opinions and when receiving critics from fellow students. The online learning represents a virtual community where students and the teacher as the community members constantly debating the issue at hand. Through process such as abstraction, explicit inference, and procedural reasoning, students engage in knowledge building.
**VR environment:** The task in the VR environment sub-system, even though was not graded, was considered a crucial part in making the case studies learnt in class became a reality. Being exposed to “real-life” crisis scenario put students in a different perspective when trying to solve the problem and making decisions. This environment can enhance sensory stimulation by providing an environment enriched with stimuli (Clark & Paivio, 1991).

**Industry panel presentation:** The industry panel presentation was also another form of knowledge delivery where students were exposed to comments and critics from experts who had 15 years of experience in the industry. Here learners as members of a group learned through interaction with the experts (Bereiter, 2002). Feedback was crucial in shaping their knowledge and understanding the application of marketing decision-making models to their written report which was due two weeks after the presentation.

Detailed explanation and analysis of the VR environment sub-system were given in section 4.2. Analysis of the sub-systems 1, 2 and 4 above are given next.
5.2.5.1 Sub-system 1 – Lectures/Tutorials

Lectures and tutorials represent an activity sub-system as shown in Figure 5.11 and which is now discussed.

**Action:** Students attempted to solve the case studies by making appropriate decisions through class discussions. The fundamental assumption here is that such discussions connect cognitive and social structures.

**Operation:** Students discuss in pairs, read case studies, and talked to someone sitting next to them.

Students were exposed to decision-making theories from the beginning of the semester during lecture for 1 hour every week immediately followed by 2 hours of...
tutorial where they applied the theories to case studies using spreadsheets and other forms of quantitative tools. During the tutorials, students worked in pairs for the tutorial case studies in the computer laboratory. The teacher posted several case studies online one week before it was due to be discussed in class. In solving the case studies, students must refer to the theories and concepts learned during lectures. The teacher allowed 20 minutes for them to read the case studies and then access the quantitative decision-making models in the form of a spreadsheet. The models were made available online and were used to aid students in solving the problems. These quantitative decision-making models were tools containing the regression analysis and other calculations related to the case studies. Other tools needed were the computer to access the models and the teacher who mediated the case studies discussions.

This socially organised practical activity is directed towards achieving a specific outcome, learning decision-making. The implications are that this intentional goal-directed activity is possible because students possess the ability to reflect on their progress towards the attainment of their goals. The teacher informed students of the goals and expected outcomes of the unit in Week 2:

Teacher: This class is basically involved in problem based learning where you will be solving case studies by making the right decisions. If you work collectively, you will achieve the outcome of learning decision-making theories and concepts and will be able to apply these theories in the real world.

From the unit outline on page 5 (see Appendix B), there was no set prescribed text for students of this unit. The teacher provided handouts and lecture notes to guide students in understanding the unit. The prerequisite for this unit was DM231 (Marketing Concepts), but no basic knowledge of decision-making skills was taught in this unit. The content of the lectures included qualitative and quantitative decision-making models; however, it was not a requirement that students must have basic statistical knowledge before enrolling in the unit. This requirement can be seen as a contradiction because during the first day of class, the teacher announced that students must have at least a basic understanding of statistics in
order to understand the unit. This anomaly is evident in the following conversation with one of the students after they finished discussing the solution to the case study:

Amy: I don’t really understand how to solve the case study.
Teacher: Can you do statistics? If you can, it would be easier to interpret the case study but if not, it’s not going to be easy.
Amy: I have no experience in using spreadsheets.
Teacher: If you don’t have any experience using spreadsheets, then you have to take extra lessons privately because it would be difficult for you to follow this class.

There seemed to be some inconsistencies between the stated unit requirements and the teacher’s needed requirements in order for students to understand the decision-making models. According to activity theory, this internal contradiction may be seen as a starting point, a sign of richness in the activity system (Nardi, 1996a).

In line with this assumption, the teacher realised the inconsistencies and immediately provided a solution to the problem. The following conversation was a continuation from the above:

Amy: Where can I take the class?
Teacher: They offer many types of statistics classes at TAFE, across the bridge from the university.
Amy: How do I register for it?
Teacher: You have to go and do it yourself.

The teacher realised that there were students who did not have the basics of statistics, which would make his teachings difficult to understand and eventually might not achieve the unit’s goal. His reaction was spontaneous when he redirected the student to a TAFE\(^4\) college close by the university where the student could

\(^4\) Technical and Further Education College. These colleges provide technical, practical and trade-based training programs at tertiary level.
learn the prerequisite knowledge. In doing this he was functioning in the activity theory sense as an information resource person and hence a tool for students to use to access necessary skills. This information was invaluable to other students in the class who were in the same position as Amy. However, from Amy’s point of view, the teacher did not actually help her develop the statistical understandings needed for the unit.

Amy realised her lack of statistical knowledge and was concerned about her level of understanding before being able to study in the class. He immediately turned to the two female students who were waiting to talk to him and said:

Amy:  Do you need extra statistical lessons too?
Lian:  Yes we do.
Amy:  Do you know where to take the course?
Lian:  I think he meant the TAFE institution
Amy:  Do you want to go together and register at TAFE?
Lian:  Yes, we can, but I need to ask him a question first.

The three female students were seen leaving the laboratory together. Later it was revealed that the other two students also did not have the statistical knowledge and was concerned about their ability to understand if they continued with the unit. As it eventuated, they withdrew from the class two weeks later as evident from the interview with the teacher in Week 3:

Researcher:  How many students do you have now?
Teacher:  I have two who withdrew from the unit. You remember the two Asian ladies who approached me last week?
Researcher:  Yes I remember.
Teacher:  Well, they emailed me the other day saying they quit. It was difficult for them because they said this class was hard. And I wished them well in their future undertakings.
It is evident that the contradictions helped clear the air about the nature of the unit early in the semester. This is true as the assumption in activity theory where contradictions are a sign of richness in the activity system.

On the first day of class, the teacher gave students a case study to solve. This was a way to familiarise students with the nature of case studies. One student was frustrated with the lack of knowledge he had in order to solve the problem in the case study, even though the purpose of the exercise was explained earlier. The following conversation between the teacher and Ben ensued:

Ben: How do you know how to solve the case study? We don’t know anything yet; this is only the first day of class?

Teacher: You do it based on your experience or on the knowledge you gained when taking the prerequisite unit for this class.

Ben: I still don’t know how to do it! I need to study first before I can solve this problem!

Teacher: This is just for me to measure the knowledge you have before I start lecturing. Just do what you know and we’ll discuss this in class afterwards.

Ben: They didn’t do this at work. You’d always get enough information first before you can solve any problems.

Ben’s reaction reflects activity theory’s assumption that in learning, a subject’s understanding was shaped by the communities and the culture they have been working and living in. He compared his learning process at University with that at his workplace. Even though this was only the first day of class, Ben was already questioning the support he got from the teacher as a tool. However, the teacher as the moderator briefly reminded Ben the purpose of the exercise in an attempt to calm him down. Unfortunately, Ben was not happy with the teacher’s explanation because after Week 4, Ben withdrew from the unit. It was also learnt later that Ben had been behaving “aggressively” in other classes as well.

Activity theory is concerned with rules developed by the community that shaped learning. This aspect was reflected in the interaction between the teacher and
students below when the teacher set the informal rules of standards during the first
day of the tutorial:

Teacher: In order to be able to solve the case studies given during
tutorials, you must learn the database and follow each module
every week diligently. Do not surf the internet. It doesn’t matter
if there are not enough computers because what is important is
the process of learning.

Here the teacher was reminding students about his expectations. He stressed the
fact that learning was still possible even without enough tools. He was exercising
his authority in the system and students were expected to follow these rules as part
of the activity system.

Activity theory suggests that new tools can be created during the process of
learning. In the example below, during a tutorial, a student with knowledge about
computers became a tool in a situation when the teacher needed help when trying
to set up the database:

Teacher: Oh dear! It doesn’t work now. Class, I can’t seem to access the
database site. Does anyone know how to do it?
Tim: Oh, you just click the button down below (pointing at the
screen)
Teacher: Was it this one?
Tim: No, the other one.
Teacher: Come and help me do this.
Tim: OK. (Tim walked over to the teacher’s computer and helped
her. He managed to access the database site.)
Teacher: Thank you Tim.

Here the teacher was using Tim as a tool to help him achieve the aim of the day’s
lesson. He was aware that if he could not access the site on time, then the tutorial
could not be continued.
Another example of where a new tool was created during the process of learning was evident in Week 5. In this exchange the teacher was talking about qualitative decision-making models and the Bayesian network. The teacher referred to the researcher, who was sitting at the back of the class observing, and made her another tool to mediate learning:

Teacher: (to students) do you know about the history of the Bayesian network?
Teacher: (to researcher) I’m sure Ros is an expert in Bayesian network. After all she’s doing her research in decision-making! (at this stage all students turned and looked at the researcher.
Researcher: Well, I learned it a few years ago, but my knowledge is not as comprehensive, but I can help.
Teacher: Class, if you want to know more about Bayesian network, you can ask Ros.

The teacher included the researcher as a tool for students to use in order to facilitate their understanding. By agreeing to help out, the researcher became a tool who moderated the learning process. Consistent with activity theory’s concept of tools, he helped increase students’ understanding of the concept.

Yet another instance where the teacher used previous tutorial as a tool for students to understand the case study problems. The following was observed during Week 9, the second last week of lectures/tutorial:

Bob: Can you explain to me how to use the statistical model?
Teacher: Were you here last week?
Bob: No.
Teacher: If you were here last week, then you should understand today’s case study. But if you were absent last week, you need to refer to last week’s tutorial because the case study was related to last week’s tutorial. You must do today’s case study on your own. You may discuss with your peers for further clarification. I will go around to see how you are doing.

(Students started going round asking other students for help)
In line with activity theory, in this situation, the teacher used previous week’s tutorial notes as a tool to moderate students’ understanding of the current week’s case study. Peer learning, as encouraged by the teacher, also acted as a tool in facilitating understanding. The notion behind activity theory that learning occurs in a social context fits the dialogical interactions among peers as part of the dynamic operation of the activity system. Reflecting on peer suggestions and comments is a form of a psychological tool along the lines of Vygotskian theory about the zone of proximal development (ZPD).

According to activity theory, the teacher was a tool who moderated students’ understanding. When teaching about quantitative decision-making models, the teacher provided further examples from real life experiences to students:

Teacher: What information do you need in a database? What type of information you need to collect?
Tina: Personal information for the company’s records?
John: Product information?

Teacher: Yes and to see examples of online databases, you can go to different websites, for example amazon.com and try to find out how they manage their database of customers.

The teacher was directing students to real world examples to facilitate their understanding in learning the quantitative decision-making models.

One of the functions of tools in activity theory is to moderate and facilitate learners’ understanding. This is evident in the following conversation when the teacher gave some feedback to students:

Teacher: I am not impressed at the kind of contributions you made. I expected something more intelligent. You must think before giving contributions in the next online forum. And because of that many of you didn’t get good grades for the first online session.

Andy: What do you mean by intelligent? Do we have to give feedback based on lectures?
Teacher: It is more than that. One way is to include current affairs.
Amy: So do you mean we have to give examples based on current affairs?

Teacher: It’s better if you can give examples, but it is not compulsory. Use current issues to frame your contributions.

Andy and Amy were asking further questions to the teacher to clarify their understanding of what the teacher wanted. The teacher acted as a tool in facilitating understanding to achieve the outcome.

In Week 8, one of the Asian students was having difficulty understanding the teacher’s explanation:

Ling: I don’t understand the regression analysis. Can you explain some more?

Teacher: Well, come and sit at my computer and I’ll tell you how it works. (Ling took his notes and sat at the teacher’s computer. The computer screen was beamed onto the wall screen for all to see.)

Teacher: Class, let’s help Tang here to understand better. (She continued explaining to Tang while the whole class looked on.) Do you understand now?

Ling: Yes, I understand better now. Thank you.

After the class, an interview with the teacher revealed that he purposely put the student in the spotlight as a learning mechanism. He called it “learning under pressure” and believed that it was one of the efficient ways to teach students. Subsequent interview with Ling revealed the tensions he confronted:

Interviewer: How do you feel being put on the spot like that?

Ling: I was afraid at first, but he told me to sit there, so I had no choice.

Interviewer: How did that experience make you feel?

Ling: I am not used to people watching me learn in class but I think it was ok. I understand better after he explained to me like that (in front of the class.)
In this case, the rules and roles of the teacher being the authority in the classroom were reflected. Tang had no choice but to follow the teacher’s instructions. His reaction is consistent with activity theory’s assumption that the rules and roles of the community (here being the teacher) shaped learner’s understanding. By conforming to this rule, Tang managed to solve his problem in understanding the concept.

One of the concerns of activity theory is the role of socio-cultural context in moderating learning. Activity theory stresses the importance of cultural background and its influences on learning. Growing up in Hong Kong, Tang reflects the typical Asian way of learning where the teacher is the authority and students are not supposed to question the teacher (Salili, 2001). The teacher, on the other hand, was concerned about Asian students not exposed to the Western style of learning. Having experienced the Chinese culture before, he was aware of how Asian students react in a class full of Western students. His action was seen as trying to immerse the Asian student into the Western style of teaching and learning. The teacher, as a mediator, used his experience to understand the Asian students’ different way of approaching learning.

From direct observation, interactions between students in the classroom were reflected from their background. Western students were more open and willing to shape their ideas without reserve, while Asian students were more reserved and were concerned about “saving face” if they gave the wrong ideas. Male, Australian students seemed to dominate the discussion while Asian students, male and female, did not join in the discussion. Different cultural and social background influenced the way they interact in the VR environment. This form of behaviour is consistent with activity theory’s assumption that the communities and the rules govern the way learners act in a learning environment. In this situation, the learning process was effective for Australian students but not for Asian students. As a result of this imbalance, Asian students were seeking outside help in understanding the unit. The following short interview was held with one of the Asian students during Week 8.
Interviewer: How do you find this class?

Tang: It’s quite difficult to cope so I get help from my seniors who explained everything to me in my own language. I find that I can understand better that way.

Ling: I am not used to this style of learning. In my country we don’t have to get involved heavily in class discussions. I think it was quite difficult.

Tang: Australians, they speak very fast. I cannot understand!

Because of lack of shared rules, different cultural expectations of what happens in a learning environment between the Australian students and the Asian students had brought about different reaction in the learning environment. This mixed interpretation of the shared rules has become a barrier in learning effectively for Asian students.

Consistent with activity theory, relationship and interaction between peers helped facilitate learning while interaction with teacher and facilitator helped understand the case problem. Interaction outside the classroom including phone and email also helped students understand better. Students were able to interpret the case studies in tutorials after getting help from their peers.

It is important for this analysis to be done to ensure deeper understanding of the lectures/tutorials instructional mode is understood. Knowledge and experiences gained from this learning environment will be transferred to the VR environment. Interrelationships between the four different sub-systems are easier to comprehend when learning that occur in each sub-system is understood.
5.2.5.2 Sub-system 2 – Online Discussion Forum

Figure 5.12. Online discussion forum.

Figure 5.12 shows the online discussion forum as an activity sub-system.

Action: Students responded and contributed to online discussion forums.

Operation: Students read other’s ideas and keyed in their own ideas online.

Students were provided with online discussion forums through the University’s Online Learning and Teaching (OLT) website and course management software. This website was dedicated to the unit being taught and one of the sub-systems is the online discussion forum. The forum discussions were held twice during the semester, once in Week 4 and Week 10. Lectures/tutorials for these weeks were cancelled in lieu of the online involvement. The teacher posted a preamble in the online discussion forum and students were asked to respond to the preamble and to other students’ opinions within the week. There was no written criteria provided for online discussion forum contributions, however, guidelines were given during one of the lectures in Week 2 of the semester:
Teacher: We have two online discussion forums for this semester. You must contribute to the online discussion which will be opened two weeks from today. I will post a preamble for you to respond to, and I will open the OLT site on the first day of the week and you have one week to write in your contributions. I expect good quality contributions from you.

During the tutorial in Week 3, the teacher spent 15 minutes with students outlining how to access the OLT website and how to key in their responses in the online discussion forum. Students were given 10 minutes to familiarise themselves with the website. At the end of the lesson, students were brought to the Board Room where they would do their presentation in Week 12 as part of the industry panel discussion event.

This session showed the teacher’s responsibilities as a moderator when he gave time for students to familiarise themselves to the online discussion forum as well as the Board Room. His role as a moderator helped alleviate students’ anxiety when presenting to the industry panel of experts.

After the session, the teacher reiterated his expectations to students:

Teacher: The depth of discussions contributes to your grades. This is going to be a peer evaluation version where you will decide what to write and who to respond to. Contributions will be judged by your classmates. You are responsible for your contributions.

After the first discussion forum, the teacher was not happy with students’ contributions. His feedback reflects that students were not clear as to what his expectations were:

Teacher: I am not impressed at the kinds of contribution you made for the discussion forum. I expected you to contribute something more intelligent. You must think before giving contributions in future. Many of you did not get good grades for the first online session.
Tom: What do you mean intelligent? Do we have to give feedback based on the lectures?
Teacher: Well, it is more than that. An example would be to include current affairs surrounding the issues and give references to your statements.

After this interaction with the teacher, students seemed to understand better the teacher’s expectations. This interaction is consistent with activity theory’s assertion that subject’s interaction with the tool mediates the learning process, thus improve understanding and achieve the desired outcome. The teacher as the moderator played his part in giving detailed explanation to students and students used the opportunity to ask questions and thus increase their understanding of the unit. On the other hand, the teacher as part of the community imparted his knowledge to the students to aid in students’ understanding. The impact of community relationship on the learning process has shaped their understanding, as has been proven from the second discussion forum, where responses were more in depth with valid references as follows:

Responses from Kim:

Melymuka (2004) suggest that decision models should create alternative ways of actions for the management team, rather than providing a fixed outcome. This means that a model must provide alternatives for the management to choose from. This means that a model must provide alternatives for the management to choose from. The model does not choose the absolute solution that is for the management team to decide.

Responses from Dean:

Kim, I must agree with you about the information quoted from Melymuka. Today many organisations seem to spend more time creating decisions rather than making them. My wife for example used to work at two different agencies and what she noticed most between the two businesses was the amount of time that was spent “creating decisions” at one agency rather that “making decisions” at the other. I guess the fact that the private business is still around today proves that you may not always require a decision-making model to be successful at what you do.
Some responses reflect the function of rules where students were expected to exercises openness in voicing out their opinions and respect others’ contributions as reflected in the below:

Responses from Glenn:

   Dean’s contribution struck me, as while debating the merits of “creating” decisions rather than “making” them, he effectively raised an issue of the choice-removal within the model used. I feel he contends that when rigidity, in the form calculated objective processes, dominates the decision “process” where a constant subjective alertness, “gut-feeling” and past experience, mixed with timely environmental monitoring could prevail, it leaves the business with an inflexible situation. I do, however, have a problem with Dean’s illustration of his point through a comparison of past experience in the private and public sectors. Drawing a conclusion of a successful decision-making by a consulting firm solely on the basis of its survival in the market is nonsensical, with no indication of performance comparisons over time.

Responses from John:

   There have been several other investigations into the naturalistic decision-making notion of satisfying. My point though, is that these academics have been able to map or illustrate in some form or another. So isn’t the gut feeling limitation slightly contradictory if these researchers have been able to model “gut feeling” decision-making?

Responses from Dean:

   In your contribution above, Steve has hit the mark in terms of addressing the limitations and evaluating the arguably impossible task of conceptualising the “gut feeling” to which so many managers resort. While I agree with his discussion, I do not agree with his statement that the limitation of being too expensive to implement.

The flow of the online discussion above shows students arguing professionally within the rules and regulations set by the teacher. They focused on the issue at hand and were not emotional when giving responses.

The teacher gave feedback in one of the tutorials for the second discussion:

   Teacher: I’m quite happy with your responses for the second forum as opposed to the first one. I can see that you fully utilised your knowledge in decision-making theories and you gave resourceful responses. I’m glad I got the message across.
The teacher’s feedback above is in support of the idea that face-to-face interaction in class between the subject and the tools in understanding the objects has achieved the desired outcome. This assertion is consistent with Throha (2003) who suggested that face-to-face interactions in online learning have positive impact on students’ understanding.

The division of labour in this sub-system was defined by the teacher’s responsibility in providing the preamble to the online discussion forum while the students were responsible for giving contributions based on the preamble and on other students’ responses. The first preamble was:

Businesses are constantly facing new challenges - information is now available globally, competition is becoming fiercer, financial pressures have increased and new products and technologies are streaming onto the market. This quote provides the context for our first discussion forum where we pose that customer relationship management is about developing models that provide the capacity and capability to manage links between the organisation and the customer.

And the second preamble was:

Is the objective of Marketing Decision-Making to reach good decisions? Although decision-making models have been proven to be effective in finding solutions to problems, Little (1970) argued that there are major limitations with them, being that management practically never uses them since good models are hard to find; they require high quality work at the design stage, are often too expensive to implement; or management simply do not understand them and resort to experience and gut feel. It can be argued that with the use of robust models and data the process of marketing decision-making can be far more effective and efficient. Critically evaluate the above comments using your knowledge of computer based models and VR.

Activity theory suggests that the structure of the activity is constrained by cultural factors including conventions (rules) and social strata (division of labour) within the context. Engeström (1987) calls attention to the mediatory role of the community and that of social structures including the division of labour and established procedures. From the online discussion forum interactions, it can be
concluded that the relationship and interaction between the students as subject helped facilitate learning thus was able to arrive at the desired outcome.

The teacher in the online discussion forum was not present to contribute or give feedback online. Salmon (2003) argues that in moderating online learning, the teacher as moderator should inspire the learners by operating the electronic environment along with students. The teacher in this study did not provide inspiration to learners, in fact, there was no sign of the teacher in the online discussion. Garrison, Anderson, and Archer (2000) argue that for a deep and meaningful online learning, the teacher must be present to create a supportive environment online. The teacher in this study was not present in the online discussion.

Understanding how students behave in this learning environment explains how it influences their behaviour in the VR environment. Familiarity with the technology-aided learning helped them orientate themselves in the VR environment.
5.2.5.3 Sub-system 3 – Industry Panel Presentation

Figure 5.13. Industry panel presentation.

The next activity sub-system analysed is the presentation made by students to the industry panel (Figure 5.13).

**Action:** Students presented in front of a panel of industry experts.

**Operation:** Students involved in group discussions, finding information and typing the report.

Students were divided into groups of 4 or 5 for the panel presentation at the end of the semester. They formed their own groups by Week 3. They were required to pick four decision-making models and apply these to their own organisation plans. Students work in groups, in and out of class for their written report and presentation. The presentation was due in Week 12, however, the written report was due two weeks after the presentation date. A panel of six industry experts with 15 years of experience in the field of Marketing gave feedback to their presentations immediately after each group had presented.
As stated in Figure 5.13, from an activity theory’s perspective, the industry panel members were the “tools” that mediate the students’ actions. Students were using the feedback and responses and engagement with the panel members as a reflection to their written report. They used feedback from the presentation to update and correct the written report. The division of labour among each member in their group was assigned early part of the semester. When preparing the written report, they consulted the teacher outside of class who helped them understand the writing process.

The industry panel was seen as moderators that were dynamic in that they provided affirmation or criticism to the students. Students, on the other hand, were involved in co-constructing the activity by presenting their written report to the industry panel. Feedback gained from the industry panel was used to facilitate the process of learning. The industry experts helped them to understand not only the application of the decision-making models to real life situation, but also the technical aspects of their presentation. Their feedback helped students to learn the best way to present in future as shown in the following responses:

Panel member 5: I think your voice kind of faltered the whole presentation which has put down the whole presentation, because once you go into a room, it’s very difficult to remember anything. And everybody is going to study it, so in each case, I think your voice need to, and the whole thing, all your data, anything that’s relevant made up into a whole and give it to the board member.

Anne: Thank you for your comments. I’ll remember to do that next time.

Another panel member asked about a student’s understanding about the BCG (Boston Consulting Group) model:

Panel member 2: Can I ask you a question about your BCG analysis, am I correct to understand that you said it’s not relevant and you can’t tell us very much?

Tim: It depends on obviously the industry and the company specifically because what it’s saying from lots of reading today is that old models are not as relevant because companies are moving towards more related units and it
(the BCG model) was made in the ‘60s where they were more unrelated units then, therefore, if you were deleting a unit you won’t be affecting any other units whereas today, according to the research the companies are moving towards that.

Panel member 2: So, you’re saying that you don’t believe the BCG analysis is useful in today’s organisation?

Bob: Well, partly, we thought we’d focus only on relevant models based on our organisation.

Panel member 2: I disagree. I think you should elaborate on the usefulness of the BCG analysis because I think it is relevant to your organisation.

Tim: Yes, thank you for your feedback, we will look into it.

From Tim’s response on behalf of his group, he agreed to take into consideration the BCG analysis for the group’s decision-making model.

Here are more responses from the panel members that helped shape students’ understanding:

Panel member 1: When you start to talk about how to apply to the business, you got my interest. I think you need to use your third proposal which is the Time Series, which was good, start with that in your report.

Dean: Well, we thought the Time Series was not the best of all the models.

Panel member 1: Oh no! no! That model fits your organisation perfectly.

Dean: OK, we’ll consider that then.

Panel member 2: Your last slide was good because you’re relating it to what I’m interested in and your information was thorough. Who prepare the slides?

Glenn: I did. I was responsible for the PowerPoint® presentation.

Panel member 2: Keep up the good work.

Panel member 3: I can see there’s a lot of information you gave, my thought was did you go back to basics and did you talk to the customers and find out what their needs were?

John: We didn’t. We sort of assume that part.
Panel member 3: You shouldn’t assume. In business you must know what your customers’ needs are and give them what they want. I tell you, it’s a very different world out there!

John: We will. Thank you for your input.

These responses show that the panel members were using their experience and expertise, as a useful tool, in guiding students’ presentation. The feedback was used to reflect on their written report before final submission two weeks after the presentation. Therefore, the interaction between students and the industry panel contributed to improved student learning.

Learning marketing decision-making through the four sub-systems; the lectures/tutorials, the online discussion forum, the VR environment and the industry panel presentation contributed to achieve the learning outcome. The lectures/tutorials helped them gain theoretical knowledge about decision-making while the online discussion forum enabled them to exchange ideas about the unit. The integration of real world relevance in the learning environment is necessary for learning to be effective (Herrington & Herrington, 2006). The VR environment was effective in giving real life simulation for students to practice their knowledge while the industry panel presentation helped students to pull together all their knowledge learnt during the semester and defended their knowledge against the experts in the industry.

Regardless of the effect of VR environment as a sub-system, evaluation of the overall system as a whole is necessary to determine its success. According to activity theory, the strength of an activity system depends on the contribution of sub-elements in the system in the form of dynamic relationships between them. Each sub-system in its own right was an activity system and their contribution to the overall activity system was important. However, for the overall activity system to be successful, these sub-systems should interact with each other to form a network of activities. How each sub-system influenced each other is further elaborated in Section 5.2.6 where Step 6 is discussed.
5.2.6 Step 6: Analysis of the Activity System Dynamics

According to activity theory, dynamic interrelationships between the sub-systems of an activity system are crucial in determining the success of the activity system. The various sub-systems of the activity system contribute to the act of knowledge building by the subjects. The learning outcomes from each sub-system were expected to contribute to the achievement of the overall goal of learning about decision-making in marketing. The following sections (1) to (6) analyse each relationship between the sub-systems followed by a summary of these interrelationships and look at how the relationships affected the overall activity system.

5.2.6.1 Online Discussion Forum and Lectures/Tutorials

The two sub-systems involving online discussion forum and lectures/tutorials were closely and effectively linked together. The teacher as a tool not only moderated the online discussion forums, but also the lectures/tutorial sessions. However, as stated before, observations of the teacher suggested his teaching practices were not informed by contemporary research on effective strategies used for online teaching as advocated by researchers such a Salmon (2003.) Even though in-class discussions about how to participate in the online discussion forum were held during tutorials, there was no indication that the teacher was present in any of the online discussions. Students had the chance to deal with their problems in accessing and navigating the online discussion forum website during these sessions. Figure 5.14 shows the relationship between online discussion forum and lectures/tutorials.
This introduction session helped students to familiarise themselves with the online environment. The teacher had increased the students’ skills to use the online system as a tool.

The students gained theoretical knowledge and concepts of decision-making from the lectures/tutorials moderated by the teacher. They transferred the knowledge gained from the lectures/tutorials to the online discussion forum. Some students referred to the knowledge gained in the lectures/tutorials to support their arguments in the online discussion forum. They also used examples given by the teacher to back up their arguments and to construct deeper understanding. The following vignette is evidence of the interrelationship between the lectures/tutorials and the online discussion forum.

Anne: Going by what I know and learnt so far in Marketing Decision-Making that we choose our decision based from either past experience, instinct or models that support them. Fortunately I have working experiences which I value as similar to learning at University. With that I know that many businesses use models to back up their choices in decision-making. They don’t necessarily call them models but it is somehow embedded into their work processes.

Quantitative decision models can help with analysing past figures and understanding the relationship on how advertising can influence sales during economic crisis or how a company approaches the challenges of overcoming a terrorist attack. There are various multiple variables which can further influence the way business runs. Qualitative decision models through the use of virtual reality can help us understand consumers’
preferences on product attributes or evaluation of service quality they receive.

I have also learnt that different models provide different scenario, and that unless we are looking for specific results that support our actions and know how to use these models to conclude our ideas, they become powerful tools in decision making. Therefore, going with what I learnt in class, I agree that models do assist with decision-making when used properly to support a specific decision. I am also glad to take that tool out into my work life knowing that when I do meet a challenge, just using company’s existing data in excel or access the past figures of sales or other averages, I am able to confidently make a decision either for business reason or personal.

Here Anne was referring to her knowledge about Marketing Decision-Making gained in lectures/tutorials. Not only that, Anne was also referring to her work experiences outside of university to support her opinion.

The second vignette below comes from John:

John: I am of the view that the initial question in the preamble regards this particular university subject and in response, I firmly believe this subject’s objective is not to just reach good decisions. This subject is designed to open the eyes of budding marketers to the implications of decisions regarding marketing constructs. To understand this, we delve into the underpinning reasoning, developed at times through models, behind such decisions. In doing so, we are required to critically analyse and manipulate the quantitative and qualitative data before us, whilst balancing the levels of subjective bias and objective reasoning. Such is the reason why answers arrived at within workshops are not considered “right”, but as the result of a rigorous process. Therefore, for success in the subject an engagement in this process on a level conducive to evaluative learning is essential. It is not a Machiavellian subject in the sense that we are redeemed by way of our final decision as we may be seen to be in regards to our final mark. If it were so, more quantitative levels of assessment would be in place (perhaps instead of analytically rewarding forums such as this). Notwithstanding the obvious importance of a final decision’s integrity, the proper appreciation of the process will yield positive results.

John was using his understanding from the lectures. He was aware that to be successful in this unit, this type of engagement was necessary. He also regards the forum as a rewarding experience.
Conversely, knowledge gained from the online discussion forum was indirectly applied in the problem solving exercises in the tutorials. Students used this knowledge regarding the benefits of decision-making models when discussing the decision-making models during tutorial sessions. However, there was no direct application of this knowledge in lectures since lectures were basically a one-way interaction.

In short, the link between the lectures/tutorials and online discussion forum was dynamic in that the instructions and preparation for contributing to the online discussion forum were held during lectures/tutorials. Knowledge gained from the online discussion forum was adapted in solving the case studies.

### 5.2.6.2 Online Discussion Forum and the VR Environment

The outcome of the online discussion forum had minimal impact on the knowledge-building activity that occurred within the context of the VR environment and vice-versa. Two observable impacts are first, lack of transfer of knowledge from the online discussion forum to the VR environment and second, few of the ideas discussed and investigated in the VR environment were utilised in the online discussion forum. Figure 5.15 is a summary of the interrelationship.

![Diagram](image)

*Figure 5.15. Relationship between the online discussion forum and VR-environment*

Firstly, knowledge gained in the VR environment could not be applied to the online discussion forum mainly because the VR environment was held two weeks after
the online discussion forum. In fact the day of the VR environment experience was the last day for students to submit their contributions online.

Secondly, lack of ideas discussed in the VR environment was referred to in the online discussion forum. Only one student referred to the VR experience in the online discussion forum:

Tang: After visiting QMI today, and having experience with the technology of VR, VR does improve the process of decision-making for marketing managers. VR gives marketing managers an opportunity to solve unforeseeable problems or crisis. In the crisis situation preset by VR, possible actions such as talk to the right person, analyse the probe with the aid of other models, or arrive at a right decision can be made. However, marketing managers should not be dependent totally on VR without their own knowledge and experience as VR is just an aid for them to make effective and efficient decisions.

Moreover, I think VR is an excellent tool for presenting new ideas or new products to the clients or audience since the simulation of the proposed ideas provides a preview or pre-experience to them. As a result, VR is a highly successful invention and companies should employ this technology in order to be more successful.

In her contribution above, it appears that Tang highly valued her experience in the VR environment. Being exposed to the crisis situation and exercising what to do during the exposure had made Tang aware what it was like to make decisions in a crisis situation. Tang’s comments seem to reflect her thinking. However, there was no specific knowledge about decision-making in her online contribution.

From the discussion above, there was a common outcome from the two sub-systems, which was to learn decision-making skills; however, there was no observable direct link between them. The interrelationship between the online discussion forum and the VR environment was focused on a one-way relationship. The connection, albeit a weak one, was more observable of VR environment on the online discussion forum on the and not the other way around.
5.2.6.3 *Online Discussion Forum and the Industry Panel Presentation*

A one way relationship was observed between the online discussion forum and the industry panel presentation. This was evident from the transfer of knowledge from one sub-system to the other. Students gained information from peers during debating about the different types of decision-making models and its usefulness in today’s organisation. This knowledge, together with their understanding from the lecture notes and tutorial case studies shaped their written report and presentation. Figure 5.16 explains the relationship.

![Diagram](Diagram.png)

Figure 5.16. Relationship between the online discussion forum and the industry panel presentation.

The following online contribution is evidence of their learned knowledge about decision-making models:

Responses from Tom:

Bruggen and Wierenga (2000) argued that marketing models are of invaluable importance in marketing. This can be true if the models used are appropriate and up to date. The right model must be used for the right purpose. But how does a marketer find the right model? By using descriptive modelling, which according to Ehrenberg, Barnard and Sharp, is to use actual and potential marketing knowledge and apply it to the given situation. Different situations need different models.

Responses from Joe:

I’m going to have to agree with Tom on this one however a model alone cannot make the decision. A model merely puts forward certain information to allow people to make decisions about a particular issue, hopefully in an easily understood format.
Responses from John:

I agree with Joe on the point that models alone do not make good businesses, it is the data, people and knowledge that is used in a model that will make it successful… I am not advocating that there is no place for models in today’s business world, what I am arguing is that it is the data, people and knowledge that they bring to the table when implementing the model that makes them useful.

Responses from Anne:

There needs to be an understanding of the limitations of any model in or for it to provide some relevant information. A model validity test is one way to ensure that the correct model is being utilised for the situation, and the limitations and confidence in the model are fully understood before making any decisions.

Responses from Tom:

I agree that measuring the effectiveness of models can be quite a challenge sometimes. A business that implements models in their decision-making, probably utilise more than just one model. If management is already too lazy to use models, how do you think they will cope with having a model to evaluate another model?

Their online arguments about the effective use of models shaped their choices of appropriate models for the written report and the presentation.

The outcome of the industry panel presentation was not clearly linked to the outcome of the online discussion forum. There was no discussion of the industry panel presentation in the online discussion forum. The impact of the online discussion forum on the industry panel presentation was indirect with no clear connection from the industry panel presentation to the online discussion forum.
5.2.6.4 *VR Environment and Industry Panel Presentation*

The relationship between the VR environment and the industry panel presentation was tenuous at best. Figure 5.17 explains the relationship.

![Diagram showing the relationship between VR environment and industry panel presentation.]

*Figure 5.17. Relationship between VR environment and industry panel presentation.*

Only one student mentioned the VR environment experience during the presentation as an example, no other links were observable. The student briefly mentioned about the VR environment during the presentation:

Andy: Last week we did a virtual reality exercise and in that we had to continually look at the cost increases as there were critical incidents in the plant like cleanups and everything in there, the variable cost per unit rises in regards to that, so you can see in that one that the breakeven almost triple.

Even though the expertise of the industry panel managed to shape students’ understanding of the application of the decision-making models, it did not have a significant impact on the VR session. This is because the industry panel presentation occurred after the VR session. Nothing in the VR session cued students to consider what they might have to do in their panel report. The teacher could have engineered the sequence so that the reports made to the panel drew upon the VR scenario and conversely he could have used the VR environment as a trial preparation for the panel discussion. Students could have been cued to write a synopsis of their decision for presentation at the panel session.
5.2.6.5 "Lectures/Tutorials and VR Environment"

The interrelationship between the lectures/tutorials and the VR environment was evident when students were able to visualise the case studies learnt in tutorials through a “real-life” environment provided by the VR simulation. Knowledge gained when solving the case studies during tutorials was used in VR environment. Students applied the knowledge in using the quantitative decision-making models in the VR case study. Figure 5.18 shows the relationship between the VR environment and the lectures/tutorials.

![Diagram](image)

*Figure 5.18. Relationship between VR environment and lectures/tutorials.*

The relationship between the VR environment and the lectures/tutorials were evident in the following statement from students in the focus group:

Interviewer: What do you think of the VR environment?
Anne: I must say, I think VR is an excellent tool for universities to incorporate in their teaching and learning to make it much clearer, compared to the databases and models we’ve been working with in class, this VR experience had just opened up my eyes for what we’re actually trying to achieve with theories learned in class.

The VR environment sub-system managed to provide students with realistic experience thus helped them to increase their understanding.

Holding the VR environment as a separate session from the lecture during the second last week of the semester virtually ensured that knowledge gained from the
VR environment had no impact on the construction of knowledge during lectures/tutorials.

5.2.6.6 Lectures/Tutorials and Industry Panel Presentation

The relationship between the lectures/tutorials and industry panel presentation sub-systems was characterised by knowledge application. Knowledge gained during lecture was applied in the written report and industry panel presentation as shown in Figure 5.19.

![Diagram of Lectures/Tutorials and Industry Panel Presentation](image)

Figure 5.19. Relationship between lectures/tutorials and industry panel presentation.

Students used knowledge about decision-making models learned during lectures/tutorials to answer questions about their chosen models for the presentation. The outcome from the industry panel presentation enhanced students’ understanding of how to apply the decision-making models in real-life organisations.

On the other hand, the industry panel presentation did not have much impact on the lectures/tutorials sub-system. Only the feedbacks and comments were later used to review their written report before the final submission. The written report was a graded assignment and was part of the unit requirement. Here, the teacher did not attempt to develop these interactions. Although he appeared to have consciously
integrated online and lectures he did not do the same for VR or the industry panel presentation.

5.3 Overall View of the Activity System

The analysis of the dynamic interrelationships of each sub-system in the overall activity system in section 5.3 above reveals that there are different levels of interrelationships that existed between the sub-systems.

The activity system in this study seemed to lack dynamic interrelationships between many of the sub-systems. The connection between each of the sub-systems was mostly one-way relationship. Figure 5.20 depicts the nature of the interrelationships between the sub-systems.

Figure 5.20. Interrelationships between sub-systems.
As is illustrated in Figure 5.20, it is clear that a dynamic two-way interaction occurred only between the online discussion forum and the lectures/tutorials. One-way only relationships were observed between the lectures/tutorials and the industry panel presentation; and the lectures/tutorial and the VR environment. Weak, one-way links existed between online discussion forum and the industry panel; the VR environment and online discussion forum; and VR environment and the industry panel presentation.

According to activity theory, strong interrelationships between sub-systems are necessary for producing a successful activity system. This patently did not occur in the activity system being investigated in this study: DM333-Marketing Decision-Making. The weak interrelationships between many of the sub-systems resulted in the activity system as a whole not performing optimally. Therefore, the harmony of the overall activity system fell short of providing adequate support to the students’ learning in the different sub-systems. Lack of connection between the sub-systems resulted in students not being able to transfer and apply effectively the knowledge learned from one learning environment to the other.

The unit was considered successful in the eyes of the students. Even though there were weak links between some of the sub-systems, students seemed to think that the system helped them achieve their goals which was to pass the unit. However, the VR environment did not achieve its potentials due to it being as an add-on to other components in the overall activity system rather than being a fully integrated component of the overall activity system. The unit as an activity system failed to achieve the intended outcomes for the university.

5.4 Modifications to the Jonassen and Rohrer-Murphy (1999) Approach for Future Research

The adaptation of the Jonassen and Rohrer-Murphy’s approach utilised in this research study consisted of six stages. On reflection at the end of the research
study, further modifications were deemed necessary to be made to the Jonassen and Rohrer-Murphy approach in order for it to be a more efficacious tool for evaluating learning environments. Therefore, a revised version of the approach has been proposed. Table 5.2 lists the adapted and modified version of the approach for future research.

Table 5.2
Modified version of Jonassen & Rohrer Murphy’s approach

<table>
<thead>
<tr>
<th>Adapted version of Jonassen &amp; Rohrer-Murphy’s (1999) Approach to this research</th>
<th>Modified version of Jonassen &amp; Rohrer-Murphy’s (1999) Approach for future research</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analyse the purpose of the activity system.</td>
<td>1. Analyse the purpose of the activity system.</td>
</tr>
<tr>
<td>2. Analyse the activity system.</td>
<td>2. Analyse activity system.</td>
</tr>
<tr>
<td>3. Analyse the tools and mediators.</td>
<td>3. Analyse the structure of the activity system.</td>
</tr>
<tr>
<td>4. Analyse the contexts.</td>
<td>4. Analyse the activity system dynamics.</td>
</tr>
<tr>
<td>5. Analyse the structure of the activity system.</td>
<td></td>
</tr>
<tr>
<td>6. Analyse the activity system dynamics.</td>
<td></td>
</tr>
</tbody>
</table>

*Note:* Adapted from Jonassen and Rohrer-Murphy (1999).

There are only four steps in the revised version of Jonassen and Rohrer-Murphy’s (1999) approach. Detail sub-questions are listed in Table 5.3.
Table 5.3  
*Modified version of Jonassen & Rohrer Murphy’s approach*

<table>
<thead>
<tr>
<th>Steps</th>
<th>Sub-questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1: Purpose and activity system</strong></td>
<td></td>
</tr>
</tbody>
</table>
| 1. Describe the activity in general. | What are the sub-activities within the overall activity?  
What chronological phases were there in the activities? |
| 2. Understand the relevant context within which the activities occur. | Where did this activity occur?  
What level of education?  
What was the unit content?  
How was the course design developed? |
| **Step 2: Analyse the activity system** | | |
| 2.1 Describe the components: | | |
| 2.1.1 Subject | Who were the subjects?  
What were their motivations and interpretations of perceived contradictions in the system? |
| 2.1.2 Object | What is the expected outcome of the activity?  
How will completing the object move the participant toward fulfilling the intentions of the individuals? Of the program? |
| 2.1.3 Tools and Mediators | What were the physical tools involved?  
Who were the mediators apart from the teacher? |
| 2.1.4 Outcome | What activities were assessed?  
What criteria were used to assess the learning outcome?  
How had completing the object moved the subjects towards fulfilling the aims of the course? |
| 2.1.5 Rules | What were the implied rules and roles of the members of the cohort of students  
What were the rules imposed by the Institution or other communities? |
| 2.1.6 Division of labour | What was the division of labour within the activity system? |
| 2.1.7 Communities | Who were the other participants and what were their roles  
Who were the communities involved. |
Table 5.2 (continued).

*Modified version of Jonassen & Rohrer Murphy’s approach*

<table>
<thead>
<tr>
<th>Steps</th>
<th>Sub-questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 3: Analyse the activity structure</strong></td>
<td></td>
</tr>
<tr>
<td>3.1 Describe the interactions occurring in each activity of the overall activity system.</td>
<td>What actions were performed and by whom during each activity?  \Who performed the actions?</td>
</tr>
<tr>
<td>3.2 Decompose the activity into components of actions and operations</td>
<td>What type of interactions occurred in the activity?  \Who were involved in the interactions?</td>
</tr>
<tr>
<td><strong>Step 4: Analyse the activity system dynamics</strong></td>
<td></td>
</tr>
<tr>
<td>4.1 Describe the interactions occurring between the sub-activities.</td>
<td>What were the interrelationships that exist within the components of the system?  \What dynamics existed between the activity systems?</td>
</tr>
</tbody>
</table>

*Note:* Adapted from Jonassen Rohrer-Murphy (1999).

It is hoped that the modified version can be a utilised for future research when evaluating learning environments.

Chapter 6 describes the theoretical conclusions derived from the analysis of data of this research.
Chapter 6: THEORETICAL CONCLUSIONS

‘I have never let my schooling interfere with my education’
- Mark Twain

6.1 Chapter Overview

The overall aim of this study was to investigate through the lenses provided by activity theory (Engeström, 1987, 2001) how students’ interactions in a VR learning environment situated in the context of a business studies unit influence the learning of decision-making skills in crisis events.

In order to address the overall aim, three research questions were investigated during the course of the research study. The findings based on the research that focused on research questions 1 and 2 were presented in chapters 4 and 5 respectively. The focus of this chapter is on research question 3:

What theoretical conclusions can be drawn on the effectiveness of virtual reality scenarios in similar contexts where VR learning environments are blended with other teaching/learning approaches?

The activity system investigated in this research study was a unit within the Bachelor of Business degree course at the university where the study was conducted: DM333 Marketing Decision-Making.

Three categories of theoretical conclusions were derived from the analysis of data:

1. Theoretical considerations with respect to the design of the VR simulation
2. Theoretical considerations with respect to the VR learning environment
3. Theoretical considerations with respect to the blending of VR simulation with other teaching/learning approaches.
Section 6.2 discusses the theoretical considerations with respect to the design of the VR simulation. Within this section, the quality of the VR simulation and quality of the interactions engendered by the VR simulation are explored. Section 6.2.3 summarises the theoretical principles derived from these discussions. Section 6.3 discusses the theoretical considerations with regard to the design of the VR learning environment. Within this section, the course design and the assessment issues are explored. Section 6.3.4 discusses the theoretical principles arriving from these discussions. Section 6.4 explores the theoretical considerations with respect to blending of VR simulation with other teaching/learning approaches and the theoretical principle related to it. Introduction of the Yahaya framework is discussed under this section. Conclusions are discussed in the final section of this chapter (section 6.5).

6.2 Theoretical Considerations: Design of the VR Simulation

Herrington, Oliver and Reeves (2003) argue that learning is enhanced when learners are exposed to learning environments that resemble the real life. The instructional strategies should recognise that learning contexts and activities should simulate experiences that allow students to derive understanding in contexts in which they need to apply that understanding. Authentic learning environments establish a sense of personal control over what and how the learner learns. When a sense of personal control is established learners should be able to pursue their own independent learning endeavours albeit guided by a supportive teacher (Watters & Ginns, 2000). The VR simulation in this study, to a certain extent, provided a learning environment that resembled real life situations: a factory environment. However, it was noted that the VR simulation had two limitations that reduced its educational impact: (1) the quality of the VR simulation itself, and (2) the quality of the interactions engendered by the VR simulation.
6.2.1 Technical Quality of the VR Simulation

The technical quality of the VR simulation was not comparable to commercial games standard. Most commercial games include technologies such as advanced 3D qualities, manoeuvrability of the object on the screen, and high quality graphics. This level of reality was not incorporated into the VR simulation used in this research. Furthermore, in this VR simulation, there was lack of factory workers images and the telephone conversation could not be integrated into the VR screen. Instead, they were added as text and were beamed onto the wall next to the VR screen. These limitations of the VR simulation were noted by students during the focus interviews and the post VR session questionnaire.

According to Herrington and Herrington (2006), it is important that the quality of the simulation to be of a standard that enables students to suspend belief of the reality of the situation and to become physically and emotionally engaged in the experience. Little emotional engagement was demonstrated by the students during the session with the VR environment.

These students’ reaction to the limited sophistication of the depicted scenario is an important signal to the education sector that VR simulation used in educational context should, when possible, comply with the technological advancements. Also, designers/developers of educational VR simulation need to ensure that their artefacts facilitate both physical and emotional engagement by the students.

However, we can also look to games theory and contemporary computer gaming strategies to acknowledge that the visual quality is only part of the power of simulations. Van Eck (2006) claimed that VR scenarios that incorporate simulations such as games succeed in engaging students in informal learning because they employ sound pedagogical approaches such as situated cognition, cognitive disequilibrium, and scaffolding to teach what is needed to succeed in the game. In reviewing the literature on the effectiveness of games there is little research that explores the quality of the visuals. What seems to be significant in
games is that they employ play theory, involve cycles of learning, are problem-based, embody situated cognition and encourage questioning and what-if scenarios. Research by Black (2007) also suggested that students (particularly more capable students) were frequently able to construct imaginary worlds based on minimal visual input.

6.2.2 Quality of the Interactions Engendered by the VR Simulation

The levels and types of interactivity that were enabled by the simulation were limited in nature. Herrington, Oliver and Reeves (2003) argue that authentic learning activities need to provide learners with the opportunity to examine the tasks from different perspectives and collaborate and reflect when solving the problem. Authentic learning must make information meaningful to the students (Lebow & Wager, 1994). In order to do so, the environment in which learning takes place must also be meaningful and be representative of the type of environment in which learning will be applied (Stein, Isaacs, & Andrews, 2004). Brown, Collins, and Duguid (1989) suggest students should use the same tools and language as experts. The culture of learning should match the culture of the experts.

Other issues in relation to multimedia learning are salient. The design of successful multimedia resources has drawn on Mayer’s (1997) generative theory of multimedia learning (e.g. Watters & Diezmann, in press). His theory advocates that effective learning occurs in multimedia environments which encourage learners to select words and images from the information, and organise these into coherent mental representations. These representations then need to be articulated and reflected upon. The extent to which this engagement and reflection occurred within the present study was limited. The VR session was implemented in one week and there was little deliberate capitalisation on the experience that required students to reflect through writing on the experience. Furthermore, as Laurillard (1999) emphasises, the resource should be interactive thus enabling students to attend to and discuss information, thereby, generating a stimulating educational experience.
This did not occur with the VR simulation utilised in this study. Little emotional engagement was demonstrated by the students during the session with the VR environment.

The VR simulation did not enable these types of interactions. For example, the VR simulation did not enable the students to control the paths of investigation and proceed more or less at their own pace. If the VR simulation had enabled this to occur, then more students could have been engaged more deeply in the problem-solving and knowledge building activity. Also, it might have enabled the more reticent students to play a more active part in the activity.

There are benefits of collaborating together on a task against the alternative benefits of being able to individually interact with the simulation, however, this study was situated in a group interaction and not as an individual learning experience. The context of immersive VR is set up for group interactions, thus individual interaction was not included as part of the research focus.

The findings of this study are suggestive that students engaged with the VR in a productive fashion. Given the context and circumstances where there were limitations in the way the VR was incorporated into the learning experience, these findings are encouraging. The extent to which the teacher factor plays a major role in the utility of the VR is an area that could be explored in future research.

In future, the design of the VR simulation should carefully consider the quality of the VR software and the level of interactivity enabled by the software. This is important to inform future design so educators can cater to the needs of the Y generation.
6.2.3 Theoretical Principles

Based on the discussion above, a set of theoretical principles informing future research and practice are outlined below:

*Theoretical Principle 1:* The VR simulation should have advanced 3D qualities, manoeuvrability of the object on the screen, and high quality graphics comparable to those found in the latest computer games\(^5\).

*Theoretical Principle 2:* The VR simulation should enable students to suspend belief of the reality of the situation and to become physically and emotionally engaged\(^6\) in the experience.

*Theoretical Principle 3:* The VR simulation should facilitate multiple levels of interaction that enable students to control the paths of investigation and proceed more or less at their own pace.

6.3 Theoretical Considerations: Design of the VR Learning Environment

Results from this study suggest that the VR environment, to a limited degree, provided an effective learning environment within itself. However, two aspects that need to be considered for future implementation of VR learning environments: (1) course design, and (2) assessment of VR learning environment tasks.

\(^5\) This could be seen as a necessary but not sufficient condition.

\(^6\) This notion of emotional engagement is consistent with Brenda Laurel’s notion of computer as theatre.
6.3.1 Course Design

The DM333 course design was originally prepared by the facilitator who intended to use VR as a key teaching event. However, events beyond the control of the researcher meant that the facilitator had in the end no input into the revision of the existing course. The researcher also played no participation at all in the design of the course. Hence the course design lacked alignment between the learning outcomes, the learning activities and the assessment tasks. The teacher was prepared to accommodate VR as an add-on component but was less than enthusiastic about its implementation. Biggs (1999) argues that constructive alignment between learning outcomes, learning activities and assessment tasks is important when designing courses. Because of lack of participation from the facilitator and the researcher in the overall design of the DM333 course, the alignment between the learning outcomes, all of the learning activities and the assessments tasks were rather superficial at best.

6.3.2 Assessment of VR Learning Environment Tasks

According to Black and William (1998), assessment is an important factor and a powerful process to enhance learning. Wiersma and Jurs (1990) argue that learning needs to be assessed to measure how well learners have mastered a particular skill or knowledge. In this study, there was no assessment of the tasks in the VR environment, thus, no measurement of student learning. Also, there was no other form of applying the knowledge and experience gained in the VR session to other teaching/learning events.

For future research, the preparation of the course design and the assessment of the VR environment tasks should be carefully planned to contribute to the enhancement of learning. One way to do this is by including everyone involved in the learning process in the overall design of the course. The theoretical principles to inform future research are listed below:
6.3.3 Theoretical Principles

In section 5.2, evidence was presented that suggested an effective learning experience was constrained by the lack of interaction between the sub-systems. The implications can be expressed through principle 4.

*Theoretical Principle 4:* The preparation of the course design intending to incorporate VR learning environments should include inputs from everyone involved such as for example the facilitator, the software developer and the researcher. This is important to ensure smooth alignment between the learning outcomes, learning activities and the assessments tasks.

The VR subsystem was not assessed. An analysis, considered in Section 4.2, of the implication of the absence of assessment, leads to the postulation of a further principle.

*Theoretical Principle 5:* The learning activities associated with the VR learning environment need to include assessment as a way to measure the learning skills learned.

6.4 Theoretical Considerations: Blending of VR Simulation with other Teaching/Learning Approaches

The VR environment in this research incorporated a crisis situation that was full of uncertainties and to a certain extent simulated real life (c.f., Lamberti & Wallace, 1987). It also was able to present large amount of data whilst at the same time enabling the learners to visualise the environment simultaneously (c.f., Gershon et al., 1998). However, there were few and limited interrelationships between the VR simulation and the other teaching/learning approaches as discussed in Section 5.2.6 and summarised in Section 5.3. This DM333 course thus failed to perform as an integrated activity system.
In order for an activity system such as the DM333 course to achieve its outcome, dynamic interrelationships should exist to support the various sub-systems (or teaching/learning approaches) activity system. This viewpoint is expressed in the following theoretical principle to inform future research.

*Theoretical Principle 6:* When VR learning environments are blended with other teaching/learning approaches, the VR environment’s learning activities should be fully integrated with those of the other teaching/learning approaches to ensure dynamic interrelationships exist between the VR environment and the other teaching/learning approaches.

This principle is encapsulated in the following proposed “Yahaya framework” shown in Figure 6.1. The framework shows how VR simulated environment should be incorporated with other teaching/learning approaches to effectively achieve the desired learning outcome.
Figure 6.1. The Yahaya framework: Embedding VR environment into teaching and learning process.

The framework has the VR simulated environment as the centre of focus. The VR environment is central to the teaching intervention so as to maximise the benefits of the VR technology. However, the on-line learning as a sub-system that is peripheral but interconnected provides a forum in which ideas are exchanged and knowledge socially constructed. The online learning feeds into the VR session as it builds knowledge but knowledge that is distributed among participants. Thus learning is situated and occurs when people conceive and share what is happening.
in the environment surrounding them (Greeno, Smith, & Moore, 1992; Lave, 1988; Lave & Wenger, 1991).

Lectures and tutorials provide opportunities for the teaching staff to provide direct instruction, to guide learners and expose them to new ideas. However lectures and workshops need to balance direct instruction with interactive approaches such as represented by cognitive apprenticeship strategies where students are enabled to acquire, develop and use cognitive tools in an authentic domain activity simulated by VR. Finally, initiatives such as industry panels provide opportunities for authentic models of practice to be embedded in the teaching sequences (Herrington & Herrington, 1998).

Within the integration process, the interrelationships of the VR environment with other sub-systems in the learning process need to be aligned. Issues such as the practicality and functionality of the system in the curriculum and the constraints and limitations of the VR system relating to the subject content must be addressed.

The circle with two directional arrows in each of the sub-system in the Yahaya framework depicts the two-way interaction within the sub-system itself. The two directional arrows between the different instructional components as sub-systems represent the dynamic relationship between them. The alignment will ensure smooth transfer of knowledge from one sub-system to the other, especially with the VR environment. Careful analysis of many different types of VR systems available out there to find one that is most suitable to the learning process is important in ensuring maximum outcome for learning.

6.5 Conclusion

Integration of technology such as immersive VR into the classroom needs careful planning and consideration. Designing the optimum learning environment requires deep analysis of each sub-system in the overall system. It also requires deep
understandings about the association between sub-systems and how they could possibly interact with each other in educationally dynamic ways.

In order to facilitate these deep analyses and understandings, six theoretical principles to evaluate/inform the design of learning systems that include VR learning environments have been generated during the course of this chapter. They are listed in Table 6-1. As is indicated in this table, the focus of Principles 1-3 is on the VR simulation itself. The focus of Principles 4-5 is on course design whilst the focus of Principle 6 is on the integration of the VR learning environment with other teaching/learning approaches within a course.
Table 6.1

*Theoretical principles for this research.*

<table>
<thead>
<tr>
<th>Focus</th>
<th>Theoretical Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VR simulation</strong></td>
<td>1) The VR simulation should have advanced 3D qualities, manoeuvrability of the object on the screen, and high quality graphics comparable to those found in the latest computer games.</td>
</tr>
<tr>
<td></td>
<td>2) The VR simulation should enable students to suspend belief of the reality of the situation and to become physically and emotionally engaged in the experience.</td>
</tr>
<tr>
<td></td>
<td>3) The VR simulation should facilitate multiple levels of interaction that enable students to control the paths of investigation and proceed more or less at their own pace.</td>
</tr>
<tr>
<td><strong>Course Design</strong></td>
<td>4) The preparation of the course design should include inputs from everyone involved. This is important to ensure smooth alignment between the learning outcomes, learning activities and the assessments tasks.</td>
</tr>
<tr>
<td></td>
<td>5) The learning activities associated with the VR learning environment need to include assessment as a way to measure the skills learned.</td>
</tr>
<tr>
<td><strong>Integration of the VR Learning Environment</strong></td>
<td>6) When VR learning environments are blended with other teaching/learning approaches, the VR environment’s learning activities should be fully integrated with those of the other teaching/learning approaches to ensure dynamic interrelationships exist between the VR environment and the other teaching/learning approaches.</td>
</tr>
</tbody>
</table>

The implications of these six principles and other outcomes of the research study are discussed in chapter 7.
Chapter 7: DISCUSSION AND RECOMMENDATIONS

‘The man of learning lives even after his death: the ignorant man is dead, while still alive.’
- Anonymous

7.1 Chapter overview

This research study set out to explore the efficacy of using VR in a naturalistic teaching and learning context. In particular the study focused on exploring three questions:

1. How do participants interact with the components of a VR learning environment situated within the context of a business studies unit that focuses on the development of decision-making skills in crisis events?

2. What relationships exist between virtual reality learning environment and other components of a unit of study that focuses on the development of decision-making skills in crisis events?

3. What theoretical conclusions can be drawn on the effectiveness of virtual reality scenarios in similar contexts where VR learning environments are blended with other teaching/learning approaches?

The major outcomes of this study are presented in section 7.2. This section revisits research questions 1, 2, and 3. Section 7.3 focuses on recommendations for areas for future study. Under this section, several issues that emerged in this study are addressed for future research in similar contexts. Implications of this study for practice in higher education in technology are the focus of Section 7.4. Finally, section 7.5 highlights the significance of this study’s contributions. The thesis concludes in section 7.6.
7.2 Major findings

Each of the findings with respect to the three research questions are summarised in the following sections. The findings with respect to research question 1 are reported in section 7.2.1; the findings with respect to research question 2 are reported in section 7.2.2, whilst the findings with respect to research question 3 are reported in section 7.2.3.

7.2.1 Research Question 1

Research question 1 focused on the interactions that occurred in the VR environment. A conceptual framework based on activity theory (Engeström, 2001) was utilised to investigate this question.

From the activity theory-based analysis of the VR learning environment, five major issues that impinged on student learning emerged: (1) student motivation/engagement, (2) cognitive challenge, (3) stimulation of prior knowledge, (4) the role of the facilitator, and (5) VR simulation as a tool.

**Student motivation/engagement.** Because the VR environment fostered active engagement in problem solving, the students worked collectively to try to find information about what was happening and reach a conclusion to the problem posed. The students co-constructed knowledge in the learning environment with the help of the facilitator. Students then adopted strategies to solve the problem which had been learnt in previous lectures or workshops and collaborated on evaluating approaches.

**Cognitive challenge.** Because VR simulation and the facilitator provided students with the cognitive challenges when solving the case study, the students were challenged to use their cognitive skills in solving the problem via a statistical
model provided. They had to engage in deep thinking to calculate the profit and loss arising out of the incident.

**Stimulation of prior knowledge.** Because the VR environment enabled the stimulation of prior knowledge, students used their previous experience learned during the lectures/tutorials to make meaning when solving the case study in the VR environment (c.f., Clements & Battista, 1990). Students were able to understand the tasks in the VR environment based on their knowledge gained in the lectures/tutorials.

**The role of the facilitator.** The facilitator played a crucial role in the construction of knowledge in the VR learning environment. He helped augment the learning process and opened up avenues for students to explore the VR environment further. The facilitator in this study provided task guidance to the students. According to Dalgarno (2004), free exploration in a 3D environment without any explicit task advice will not lead to learning advantages. Task guidance is important and that this guidance could be provided either within the environment or through support materials. Task guidance provided by the facilitator in this study can also be related to the idea of scaffolding and communities of practice in the constructivists view (Vygotsky, 1978; Brown, et al., 1989).

**VR simulation as a tool.** The VR simulation provided a real-life simulation that was relevant to the case study. This is consistent with the characteristics of an authentic learning environment which was to provide real world relevance (Herrington & Oliver, 2000). Consistent with dual-coding cognitive theory, the VR environment was enriched with stimuli which prompted learners to learn better (Paivio, 1975). However, the quality of the simulation did not appeal to a group of students who had previous experience in the game technology. Interactivity in the VR environment helped increase learning. Students were involved and actively engaged in solving the problem.
7.2.2 Research Question 2

Research question 2 explores the dynamic interaction between the VR environment and the other sub-systems. In relation to research question 2, the study found that the relationship between the other sub-systems was either a one-way relationship or weak one-way relationship. The overall activity thus failed to meet its outcome of facilitating learning decision-making because of lack of interconnection between the sub-systems.

If the unit is considered as an activity system, then each sub-system represented by the various teaching and learning events plays a key role in fostering learning. Interaction with each sub-system should feed information to the other sub-systems, and thus create a transfer of knowledge between them and the VR environment. Because of the weak interrelationships, the VR environment was not utilised to its fullest potential. Failure on the part of the teacher to acknowledge and capitalise on the VR experience meant that the experience was not viewed as integral to the unit by both students and herself and not valued as a worthwhile activity. Such a situation is inconsistent with activity theory’s principles that, in order for an activity to be successful, there must exist a dynamic interrelationship between the sub-systems (Engeström, 1987; 2001).

7.2.3 Research Question 3

Several theoretical principles were derived from results of the study. Three categories of theoretical principles were identified: (1) design of the VR simulation, (2) the VR learning environment, and (3) the blending of VR simulation with other teaching/learning events.

First, the quality of the VR simulation should allow learners to suspend belief and multiple levels of interaction should be introduced in the software to allow individual learners to proceed at their own pace. Second, the VR learning environment should take into consideration the development of the course design.
It is important to acquire inputs from people involved in the learning process, designing of the assessment of the VR environment. Third, the introduction of a new model of embedding VR as part of the learning process: the Yahaya framework. The Yahaya framework provides guidance to future implementation of VR technology into the university classroom from activity theory’s point of view. In the framework, VR was the main focus of the learning process. With dynamic interrelationships occurring within and between the sub-systems, it is proposed that this framework has the potential to enhance learning with VR technology.

The theoretical principles were developed after careful considerations of several issues that emerged out of this study. These issues are discussed below.

7.3 Areas for Future Research

In retrospect, four major issues emerged in these studies which need to be addressed in future research: (1) lack of researcher input, (2) the methodology adopted for this research, (3) the limited generalisability to other subject contents, and (4) the design of the VR scenario. Future research attempting to incorporate VR immersive environment should take these issues into consideration.

**Lack of researcher input.** Methodologically, the researcher was a non-participant observer during the course of the teaching. The design of the VR environment and tasks were undertaken by the researcher and facilitator with limited collaboration with the teacher. The teacher was prepared to accommodate VR in the teaching/learning process, but was less than passionate about its implementation. To ensure smooth transition of knowledge from one teaching event to the other, future research should carefully consider the beliefs and commitment of the teacher to the process because this will influence the effectiveness of the design of the course outline.
**Methodology adopted.** The researcher as a non-participant in the naturalistic environment is more real that if she had done the teaching herself. However, design experiment methodology provides an alternative view to this study. Design experiment is a research methodology that blends empirical educational research with the theory-driven design of learning environments. It is an important methodology for understanding how, when, and why educational innovations work in practice (Baumgartner et al., 2003; Brown, 1992; Kelly, 2003).

This methodology allows reviewing reasons for success and failure beyond pronouncements that a design “worked” or not. Two principles of design experiment were not appropriate for this research; lack of researcher’s involvement in the design process, and the non-availability of design cycles which weakened the approach. It is suggested that future research adopt this methodology provided the researcher was involved in the course design so the design cycles can be managed effectively.

**Limited generalisability.** The VR simulation used in this study was specific to marketing decision-making. Therefore, many of the specific findings from this study may not be able to be generalised to other subject areas. However, the six theoretical principles and the modification of the Jonassen and Rohrer-Murphy (1999) probably can be generalised to other contexts involving the use of VR learning environments. As in any case study approach, the findings are specific to the individual case. The logic of case study requires repetition with theoretical propositions being conjectured from one case and being explored in subsequent cases.

**Design of VR scenario.** The VR technology was relatively simple and affordable. Pragmatically, the design of the scenario and accompanying software coding was within the means of most university programming departments and teaching support groups. The quality and sophistication of the software was limited and required the engagement of the facilitator to provide interactivity. Given the increasing sophistication of games and the increasing access to this level of
programming expertise, future research needs to examine the relationship between
the quality of the technology/software and the complexity of the scenario or
content of the simulation.

Consideration of the issues discussed above in future research will result in the
refinement of technology-aided teaching and learning process. New technology
requires new approaches in the classroom. The next section discusses the
implications of this study for practice in higher education.

7.4 Implications for Practice in Higher Education and in
Technology/VR

Two major implications for practice in higher education and technology/VR
emerged from this study. First, the application of VR technology in designing the
teaching/learning approaches for higher education, and second, the application of
Jonassen and Rohrer-Murphy’s (1999) approach to research in technology-
enhanced constructivist learning environment. These implications are discussed in
turn below.

7.4.1 Application of VR Technology

This study investigated novel ways to teach workplace learning in business
faculties especially when using case method teaching approach. The introduction of
the VR technology as part of the sub-systems in this research has contributed to a
better understanding of the learning environment. Design and development of such
learning environments in future need to carefully study the links between VR
technology and other teaching/learning approaches. This definition of links is
necessary to achieve the learning outcome that benefits both the teachers and
students. VR technology has been shown to facilitate and improve the quality of
decision-making by reducing information overload and by augmenting the
cognitive limitations and rationality bounds of decision makers (Levy & Powell,
To realise the potential benefits of the VR environment as part of a learning process, the Yahaya framework is proposed. This framework is expected to capitalise on the authentic learning environment principles where importance is placed on the connectedness of the different teaching/learning approaches embedded in a learning process to deliver effective learning.

7.4.2 Application of the Jonassen and Rohrer-Murphy (1999) Approach

The Jonassen and Rohrer-Murphy (1999) activity theory approach was originally intended for designing constructivist learning environments. However, in this study, the approach was not used for its originally intended purpose; instead, it was used in evaluating an existing learning environment. For future research, modifications to the approach are necessary to adapt to the VR learning environment and the type of technology associated with it. As explained in Section 5.4, the modified version can be adapted to suit future research in this area.

7.5 Contributions

An overarching theme in this research study was to investigate effective ways to incorporate immersive VR environment as part of authentic learning environment in higher education. This study has provided results that arguably are highly significant in the rapid advancement in the field of technology in higher education, specifically VR technology. Advancement in digital technology has changed the traditional classroom setting into one equipped with computers loaded with the latest version of educational software. With the game-technology becoming readily available and affordable to students and with the decreasing costs of technology, it is imperative that the future of VR in education be explored further involving other knowledge subjects to contribute to the creation of a cutting-edge learning environment that can benefit the future generation.
Researchers and theorists alike agree on the lack of pedagogical considerations when implementing technology-based learning environments (Duderstadt, Atkins & van Houweling, 2002). It is argued that the rise in technology-supported learning environments is in line with constructivist principles of learning and teaching (Tam, 2000), however, application of the principles was restricted to learning in specific types of technology-supported environment such as e-learning and distance-learning. Because of the dearth of research in the area of VR technology-aided learning environment, this study has positioned itself in the field of instructional design in technology-supported constructivist learning environment, specifically, VR-supported learning environment.

The Yahaya framework generated in this research study provides a comprehensive approach for integrating VR technology into the teaching and learning process. The different teaching/learning events are designed to interact with the VR environment to create an authentic learning environment. This framework is expected to enhance teaching and learning process and if augmented with proper planning and designing for integrating VR technology into the classroom, has the potential to produce desirable learning outcomes.

Activity theory has been found to be helpful in classifying material objects that subjects transform through the use of different types of artefacts (Engeström, Miettinen, & Punamaki, 1999; Nardi, 1996a). Activity theory has been widely applied to the analysis of the use of technology but few explicit examples are reported in the literature that seek to elaborate on the processes or outcomes. However, hitherto it has not been used to any great extent to address issues of classroom learning and teaching, in which the object is purportedly the understanding of events, concepts, and theoretical relationships in its naturalistic setting.
7.6 Conclusion

Designing a VR environment to complement other teaching/learning approaches is an intricate task which requires a lot of careful planning and designing. The challenges and difficulties teachers face in integrating VR learning environments into the traditional curriculum and classroom structures are formidable. Teachers need to have a thorough understanding of the type of VR simulation needed for integration into the learning process. Adjusting the curriculum to fit the VR learning environment is another aspect to explore. It is hoped that this research will provide a guide in planning and implementing VR learning environment in ensuring a smooth VR immersive experience for students.
REFERENCES


Diezmann, C. M., & Watters, J. J. (in review). Using multimedia inputs to transform knowledge in science teacher education. *Journal of Science Education and Technology*.


APPENDICES

APPENDIX A

VR Marketing Case

Background on the company

Golden Foods Company is a long established local company producing canned fruits and vegetables, bottled fruit juices and soft drinks, and canned and bottled jams. The company has a small marketing department handling product development, promotion and market research.

The situation

A few months ago, you and your marketing team negotiated a special deal with one of the company’s retail clients IGO (Independent Grocery Outlets) for the supply of a batch of 18,000 bottles of Jaboticaba jam. Only one local producer grows this rare South American fruit and seasonal conditions limit its availability at other times of the year. By special arrangement with the grower, your company has managed to secure enough of the crop to fill the retail client’s special order. No more of the fruit is now available.

The client company is planning to use the product as a store giveaway item to generate store traffic in its chain of independent grocery stores. This will involve featured advertising in store brochures and in-store displays.

At the time, you negotiated a special pricing deal based on the higher than average cost of production associated with producing a relatively small batch of product compared to the usual high volume production runs for more common jams such as breakfast marmalade. Your company’s accountant has advised that the cost of production including packaging and labelling is $5.00 per unit. Using the company’s standard mark-up for special orders of 40% at cost, your price was set
at $7.00 per unit. You also agreed that the complete batch of product would be supplied by early August (it is now middle of July).

For the past month, everything appeared to be running smoothly with the order, but today, you found out that there has been an unexpected major machine breakdown at the factory. You are now no longer able to meet the demand by early August and you expected the repair will cause delay until September.

Tasks

You are the Managing Director of the company. Your task is to review the information in the case and based on your experience and existing knowledge in the process of decision making, you are to decide on the following:

a) What information is important in this situation?

b) How would you go about obtaining this information?

c) How would you determine what options you have?

d) What is your course of action now (consider how this will affect relationship with the client company, the loss incurred to your company etc.)

e) Summarise a possible step-by-step decision making process involved in (d) above.
APPENDIX B

DM333 – Unit Outline

University of Technology

Faculty of Business

Unit Outline

DM333 Marketing Decision Making

<table>
<thead>
<tr>
<th>Credit Points</th>
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<tbody>
<tr>
<td>Semester/Year of Offer</td>
<td>Semester 2, 2004</td>
</tr>
<tr>
<td>Discipline Code</td>
<td>0805050</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
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<tr>
<td>Corequisite(s)</td>
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<td>Incompatible Units</td>
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<td>Major Course Codes</td>
<td>BS78</td>
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<tr>
<td>Unit Coordinator</td>
<td>Name: Shanon Singh</td>
</tr>
<tr>
<td></td>
<td>Phone: TBA</td>
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<td></td>
<td>Fax: TBA</td>
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</table>

RATIONALE

This unit provides you with an opportunity to advance your marketing knowledge and skills beyond fundamental concepts gained in other units, by building skills in marketing decision-making.
Aims

The aim of this unit is to provide undergraduate students with knowledge and skills in marketing decision-making that can be readily translated to the work environment in a marketing career.

Objectives

To provide you with theoretical and application skills in marketing decision-making.

To build analytical and decision-making competence through the application of contemporary computer programs such as spreadsheets and databases.

To provide flexibility in both delivery and learning environment to aid comprehension and capability.

Content

<table>
<thead>
<tr>
<th>Week</th>
<th>Week Commencing</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19 July</td>
<td>Introduction to the Course. Marketing decision models, marketing information systems, databases and spreadsheets.</td>
</tr>
<tr>
<td>3</td>
<td>2 August</td>
<td>Relationships and loyalty: theory and analysis. Customer Relationship Management (CRM) decisions.</td>
</tr>
<tr>
<td>4</td>
<td>9 August</td>
<td>Online database activity Online discussion group session.</td>
</tr>
<tr>
<td>5</td>
<td>16 August</td>
<td>Service Mapping; Blueprinting and Critical Path Analysis.</td>
</tr>
<tr>
<td>6</td>
<td>23 August</td>
<td>Time Series and Multiple Regression Analysis.</td>
</tr>
<tr>
<td>Week</td>
<td>Date</td>
<td>Activity</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>7</td>
<td>30 August</td>
<td>Online exercises and activities and feedback session.</td>
</tr>
<tr>
<td>8</td>
<td>6 September</td>
<td>Tactical marketing decision-making: Product and pricing analysis.</td>
</tr>
<tr>
<td>9</td>
<td>13 September</td>
<td>Tactical marketing decision-making Promotion and Distribution decisions.</td>
</tr>
<tr>
<td>10</td>
<td>20 September</td>
<td>Online modeling exercises and activities and discussion group session.</td>
</tr>
<tr>
<td></td>
<td>27/9 – 1/10</td>
<td>Mid-Semester Break</td>
</tr>
<tr>
<td>11</td>
<td>4 October</td>
<td>Virtual Reality and the future of marketing decision- making.</td>
</tr>
<tr>
<td>12</td>
<td>11 October</td>
<td>Presentations and Industry Panel.</td>
</tr>
<tr>
<td>13</td>
<td>18 October</td>
<td>Review and final test.</td>
</tr>
</tbody>
</table>

**TEACHING & LEARNING APPROACHES**

Lectures and tutorials will discuss and model current marketing decision-making practice via computer exercises and case studies to ensure students have a sound understanding of, and the opportunity to apply, current practice methods. Students can apply and add to the decision-making frameworks in tutorials and assessment.

**ASSESSMENT**

The assessment in this unit aims to support your achievement of the learning objectives for both Discipline Knowledge and Other Graduate Capabilities. Assessment has been designed in order to allow you to:

Receive feedback on your learning as you progress toward the development of knowledge, understanding, skills and attitudes (formative assessment); and

Demonstrate your learning in order to achieve a final grade (summative assessment).
# Summary of Assessment

<table>
<thead>
<tr>
<th>Item</th>
<th>Title</th>
<th>Objectives</th>
<th>Due Date</th>
<th>Weight</th>
<th>Type (Formative or Summative)</th>
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<tbody>
<tr>
<td>1.</td>
<td>Marketing Decision-Making Models Analysis and Report</td>
<td>1,2,3</td>
<td>25 October</td>
<td>25%</td>
<td>Summative</td>
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<td>2.</td>
<td>Marketing Decision-Making Industry Presentation</td>
<td>1,2,3</td>
<td>11 October</td>
<td>15%</td>
<td>Summative</td>
</tr>
<tr>
<td>3.</td>
<td>Online discussion forum</td>
<td>1,2,3</td>
<td>Weeks 4 and 10</td>
<td>10%</td>
<td>Summative</td>
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<tr>
<td>4.</td>
<td>Final Examination</td>
<td>1,2,3</td>
<td>18 October</td>
<td>40%</td>
<td>Summative</td>
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<td></td>
<td>Total</td>
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</tbody>
</table>

Details of Assessment

Details of all assessment items will be made available on the units OLT site at www.olt.qut.edu.au/bus/AMB352.

Assessment Item 1

**Title:** Marketing Decision-Making Models Analysis and Report

**Purpose:** To provide theoretical understanding and application of marketing decision-making.

**Length or Duration:** 2500 words

**Group or Individual:** Individual

**Optional or Compulsory:** Compulsory

**Description:** This case is concerned specifically with models used for marketing decision-making. Marketing decision-making models appear to either provide quantitative data that can be statistically analysed to provide...
trends used to substantiate decisions or alternately the models can be qualitative such as flowcharts to provide ethnographic evidence for marketing decision-making. While each type of decision-making model has specific applications in industry some models may be more effective in the current marketing climate. Your exploration will investigate and then highlight the advantages and disadvantages of these models. In consultation with your tutor/lecturer choose 2 qualitative and 2 quantitative models used for marketing decision-making and research the theoretical framework. These models will have application in the workplace but do they work? Why? How do we measure their effectiveness? In what scenario would these models be most and least effective and why? What are the gaps in applying these models to a workplace situation? How could these models be either adapted or transformed to become more effective in the workplace. Provide some examples from industry that justify your recommendations.

Full details including assistance with how the case should be written, will be available on the unit’s OLT web site.

**Assessment Item 2**

**Title**   Marketing Decision-Making Industry Presentation

**Purpose:** To provide theoretical understanding and application of marketing decision-making and flexibility in the comprehension of the material

**Length or Duration:** 15 minutes

**Group or Individual:** Group

**Optional or Compulsory:** Compulsory

**Description:** Your group is required to make a 20 minute presentation to the class and a panel of industry executives. Your brief is to sell your preferred model to the panel of executives however you are asked to supply an explanation and workplace application of the 4 models then highlight and sell the benefits of the proposed model. This will include an explanation of the strengths and weaknesses of the models and any their information that will help the panel make a definite decision. The background of the panel members is each have 15 years working in the product and service markets in large competitive industries that are rapidly moving into the global environment. These industries target the general public through the use of
different sized distribution channels. It is strongly recommended to use at least PowerPoint® for your presentation. Presentations will be formally graded and there will be a peer mark for this assessment. The presentations will be made in a lecture theatre in Week 12 of the semester. Details will be discussed in class and made available on the unit’s OLT web.

Assessment Item 3

Title  Online discussion forums

Purpose:  To provide flexibility in both delivery and learning environment to aid comprehension and capability

Length or Duration:  N/A

Group or Individual:  Individual

Optional or Compulsory:  Compulsory

Description: During the semester, there will be two online discussion forums aimed at exploring questions about specific aspects of marketing decision-making. Your lecturers and tutors will lead the discussion by posing issues, and your responses will be recorded on the OLT web site. You will have an opportunity to expand the discussion by posing your own (related) issues. Each session will be open for a period of two (2) weeks. You may want to use the tutorial labs for your OLT web access.

Your involvement in the online discussion sessions will be monitored from your contributions. A total of 20% of assessment will be awarded for participation in this activity – 10% for each online session.

Assessment Item 4

Title  Final Examination

Purpose:  To build analytical and decision-making competence through the application of contemporary computer programs such as spreadsheets and databases

Length or Duration:  90 minutes

Group or Individual:  Individual

Optional or Compulsory:  Compulsory
**Description:** This test will be 90 minutes duration and will be held in the tutorial rooms during your tutorial time. The content of this exam will be drawn from the modeling exercises covered during the entire semester.

The exam format and details will be available on the unit's OLT web site during the semester:

**Determining Final Grades**

The Faculty Academic Board determines student grades. The Unit Coordinators provide the detailed assessment results to the Board, working through the relevant School. These results are advisory in nature and do not necessarily constitute the final grades awarded by the Board. In its decisions the Board compares results both within units and programs, using as a guide a set of standard distribution criteria. These criteria help the Board to ensure consistency in the marking and grading of students as applied across the faculty. These guidelines are not applied in a prescriptive fashion.

**Student Rules and Assessment Procedures**

Students are responsible for both knowing and abiding by all rules relating to assessment, academic dishonesty, non-discriminatory language, conduct and performance as contained in the QUT Manual of Policies of Procedures and the Student Charter. Details of these rules and policies, how they will be applied in this and other units, guidelines to assist you in understanding them, as well as penalties for non compliance, can be found via the Rules and Policies link on the On-Line Learning and Teaching Site for this unit.

**RESOURCE MATERIALS**

**Prescribed Texts**

No set text.

**Additional Resources**

The following are useful references, including textbooks, journals and websites. Additional references can also be found at the unit's OLT site: www.olt.qut.edu.au/bus/AMB352.


Journals, Magazines & Websites

Harvard Business Review
Marketing Journal
European Journal of Marketing
Marketing Intelligence and Planning
Management Decision
Journal of Consumer Marketing
International Marketing Review
The Journal of Business and Industrial Marketing
International Marketing Review
Management Science
International Journal of Bank Marketing
Journal of Fashion Marketing and Management
UNIT COSTS TO STUDENTS

There are no out-of-the-ordinary costs associated with this unit.

RISK MANAGEMENT

There are no out-of-the-ordinary risks associated with lectures or tutorials in this unit. You should, however, familiarise yourself with evacuation procedures operating in the buildings in which you attend classes.

STUDENT CONSULTATION

<table>
<thead>
<tr>
<th>Name</th>
<th>Room No.</th>
<th>Ext. No.</th>
<th>Time</th>
<th>Day</th>
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<tr>
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</tbody>
</table>

Staff will be available in the nominated room during the hours indicated. (Check staff rooms notice boards). Students should endeavour to contact staff during these hours, as staff may not be available at other times.

Unit outline prepared by Shanon Singh

Chair, School Teaching & Learning Committee   Date
APPENDIX C

Website for the VR-Enhanced Teaching and Learning Environment
Student information

By now you would have read the student information for Virtual Golden Foods Corporation, VGFC is a virtual corporation whose activities and case studies relate to the food industry and retail sector. These case studies are integrated within unit offerings and are detailed as you enter each department. When you work through the VGFC case studies, you will be asked to undertake a number of tasks. It is in the use of engagement assessment instruments and how you will proceed with completing the assessments are detailed in the departmental episodes of the website. You are advised to consult with your Unit Coordinator for any queries relating to the case study activity and exercises in VGFC and how they form part of the assessment for the unit.

VGFC case studies found on this website have been integrated into the teaching plan of the following units:

- B2156 - Marketing
- B2157 - Food: Science and Industry Environment
- B2158 - European Foods

These pages are text viewed in Internet Explorer v5.5 or later on PC and Mozilla v1.4 on Mac. The UIT system is developed and maintained by IT/UIT.

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Staff information

Virtual Golden Foods Corporation is a teaching resource that has been designed to provide you with virtual reality (VR) simulations based on crisis events in a food company. It is based on the metaphor of a corporation comprised of different departments and service areas that all map to the various disciplines in a business institution/organisation. Using the events that are presented in the simulation, it allows you to design case studies that seek to engage students in case-making, role-playing, problem-solving, and negotiation skills. By integrating theoretical concepts and principles within the case study design, it allows students to practice their application within a highly realistic environment, a situation that is not easily achieved during simulations or role-plays.

Whether you decide to use VGFC in the classroom or as a virtual reality theatre such as VRtual, VGtav or VST at UoL, a pilot study concluded that data produced in a single classroom theatre and virtual reality setting provides similar and authentic experiences for developing managerial capabilities and essential skills. These studies are provided below:

The conduct of existing case studies on the VGFC site is designed for the units below. It is the aim of this project to add to the suite of case studies so that all design a case study by:

- Identifying designs for the various scenarios that could arise in a crisis environment such as those presented in the food company of VGFC.
- Using the case studies to design activities that will engage students in decision-making, role-playing, problem-solving, and negotiation skills while using the theoretical concepts that were taught in a classroom setting.
- Suit their assessment and evaluation.
Advertising, Marketing and Public Relations

The goal of this department is to capitalise on the natural synergy between marketing, public relations and advertising, and to design and develop programs and scholarships that are highly relevant to these professions. The programs reflect a real-world orientation, and the focus is on providing discipline-specific learning as well as the generic skills of critical thinking, problem solving, decision making and oral and written communication. The focus is also on helping learners get their first full-time position while equipping them with the skills and perspectives that will serve them well throughout their careers. The programs are also aimed at learners who are seeking advanced skills in their profession or who are considering a career change.

Mission

The Mission of the department is to help students, staff, industry and our discipline (advertising, marketing, public relations, and integrated marketing communications) develop through providing an integrated and supportive learning, research and service environment.

Vision

The Vision of the department is to be the destination of choice for students, staff and industry for undergraduate and postgraduate study in advertising, marketing, public relations, and integrated marketing communication in Australia.
Jaboticaba Jam Case Study

Background of the Company

Virtual Golden Foods Corporation is a long established local company producing canned fruits and vegetables, bottled fruit juices and soft drinks, and canned and bottled jams. The company has a small marketing department handling product development, promotion and market research. You may refer to the Jam Process Flow diagram below to better understand the process of producing jam at the company.

The Situation

A few months ago, you and your marketing team negotiated a special deal with one of the company’s retail clients IGO (Independent Grocery Outlets) for the supply of a batch of 15,000 bottles of Jaboticaba Jam. Only one local producer grows this rare South American fruit and seasonal conditions limit its availability at other times of the year. By special arrangement with the grower, your company has managed to secure enough of the crop to fill the retail client’s special order. No more of the fruit is now available.

The client company is planning to use the product as a store giveaway item to generate store traffic in its chain of independent grocery stores. This will involve featured advertising in store brochures and in-store displays.

At the time, you negotiated a special pricing deal based on the higher than average cost of production associated with producing a relatively small batch of product compared to the usual high volume production runs for more common jams such as breakfast marmalade. Your company’s accountant has advised that the cost of production including packaging and labelling is $5.50 per unit. Using the company’s standard mark-up for special orders of 40% at costs, your price was set at $7.00 per unit. You also agreed that the complete batch of product would be supplied by the end of September.

At the moment, everything appears to be running smoothly with the order, but as a routine check, you and your team review all such orders on a regular basis to determine if there are any factors that might have changed since the time of the order.

Jam Process Flow Diagram

The Jam Process Flow diagram below shows how jam is produced from the first stage to the final stage as shown by the black arrows. The flow begins when raw jaboticaba fruits are crushed and processed until it reaches the storage stage before being distributed to customers.
Directions to QMI Solutions Virtual Reality Lab

Address Details:
QMI Solutions
Cnr Miles Platting & Logan Rds
Eight Mile Plains QLD 4113
Australia

Phone / Fax:
Phone: +61 7 3364 0700
Fax: +61 7 3364 0788

Email:
info@qmisolutions.com.au

Location:
about 10mins south of the Brisbane CBD.

Food Canning Factory

The visit to the VGRID food canning factory is a scheduled activity called the TABOTICABA 3.4 CASE STUDY. Details such as time, day and venue will be scheduled by your Unit Coordinator. During that time access to the virtual food canning factory simulation will be available on this site by a "Enter the food canning factory" link below. Please refer to case study information and fire VR risk information prior to the scheduled visit.

This case study exercise is used to support conceptual understanding and application of marketing models in a simulated incident at the factory. The objectives in this unit are supported by specific outcomes that are expected of students at the end of the exercise.

Requirements:
Catsim 4.2 plugin is needed to navigate through the VR simulations. Download the plugin and follow the auto-install procedures. Access Catsim User's Guide on how to use the control panel (opens in a separate window).

Enter the food canning factory

Page views www.31530955:878
Conducting the VR simulation exercise and case study (staff access only)

*Students who access this page will not see any resources on this page.*

**JABOTICA BA CASE STUDY EXERCISE**

**Instructions and Procedure**

Prior knowledge requirement: Marketing decision-making models

The visit to the VGFC food canning factory is supported by a number of scaffolding activities and information found as links on the left-hand menu of this page. The exercise is to be conducted at 

1. Inform students that they are required to be familiar with the information provided on the left-hand menu.
2. The VGFC food canning factory is currently a hidden link in the "Visit the food canning factory" page and should only be set to default on the day of the exercise and for students to revisit at the end of the exercise.
3. Organise the class into groups of 10 - 15 and conduct the exercise by groups.
4. Discuss the objectives of the exercise.
5. Review the case study scenario with the students and the role that they are required to play during the exercise.
6. Play the VR simulation of the food canning factory.
7. At the end of the simulation, initiate the discussion by prompting students to identify the issues and to provide solutions to the problems. Advise them that they have access to a number of resources via the audio feedback section.

**On the day of the exercise:**

1. Provide a summary of the audio feedback.
2. Provide a summary of the exercise and discussion.

Support materials:

- **VR simulation (VRML version of Food Canning Factory)** - you will need to download Cartona 4.2 plugin.
- **Audio feedback console** (opens as a separate window) - use this to select responses from VGFC personnel and client representatives when requested by students during the discussion.
- **Sample map video** - provided below as examples of a walkthroughs or navigation paths through the VR simulation showing the trigger marks to stimulate crisis events. You will need to download the FREE Quicktime Player or Real Player to view these. Alternatively, you may also access the files on the VGFC Resources CD-ROM:
APPENDIX D

Snippets of the VR simulation (as shown on the website)