

# **Sustainable use of MOODLE as a Learning Management System within a School Context**

**Gregory Peter Wilson**

Dip Ed QUT, B Ed (Admin) Deakin, M Ed USQ.

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## **Abstract**

Education Queensland (EQ) schools are increasingly using Information Communication Technologies (ICTs) for student learning and other school functions. EQ is also incorporating ICT applications to streamline school management practices. This research examines the implementation of a Learning Management System (LMS), MOODLE (Modular Object Oriented Dynamic Learning Environment) at a large semi-rural high school. The use of MOODLE is in response to EQ *key* ICT objectives outlined under the State Government's 2007 Smart State policy. The research used an exploratory case study methodology to examine the implementation of MOODLE at the school. Sustainability literature was used to examine the key measures to identify changes in ICT practices at the school by students, teachers and other school staff.

Findings from the research revealed that students quickly incorporate LMS features for learning and other purposes. Students' familiarity with technology influenced the use of new applications and wider application use across the system. Also it was found that teaching practices changed in response to implementing a localised LMS, MOODLE, which in turn resulted in an increased use of the site. The literature identified that a sustainable implementation of ICT practices requires five essential *markers* to be considered. Identified through this research were the technical considerations in provisioning LMS as well as staff considerations that facilitated enabling use of the LMS. It was concluded from the findings that localised control is a critical component to assure continued growth and sustainability of the LMS. Results from this research are being used to develop a framework for EQ schools to develop their own localised ICT practice within the school community.

## **Glossary of terms**

It is important for this research that the meanings and use of key words, terms and concepts that are used, be made clear because many terms are specific within the context of the research undertaken. This preliminary section describes the terms commonly used in this dissertation as they have particular meaning in the context of this research.

### **Blackboard**

Blackboard is a Learning Management System (LMS) that is used by Education Queensland. The Blackboard Learning System is a web-based server software platform. Features include course management, a customizable open architecture, and a scalable design that allows for integration with student information systems and authentication protocols. It may be installed on local servers or hosted by Blackboard ASP Solutions. Its main purposes are to add online elements to courses traditionally delivered face-to-face and to develop completely online courses with few or no face-to-face meetings.

### **Information and Communication Technologies (ICTs)**

Information and Communication Technologies (ICTs) include those technologies that are used for accessing, transferring, gathering, manipulating and presenting information. These technologies include computers, the Internet, telephone and other electronic devices. The use of ICTs can facilitate information sharing and the development of new knowledge. ICT is also used to refer to the singular expression, Information and Communication Technology.

### **Learning community**

This dissertation will use the meaning of *learning community* as defined by Sévigny & Prévost (2006, p. 3): “A learning community is a territorial entity in which the population--individuals as well as public/non-public organizations— is mobilized to foster a state of permanent alertness. Members of the public undertake discussions, through ICTs and other means, then try the most productive approaches to development, which as a consequence contributes to collective knowledge. In addition to promoting the use of ICTs, a learning community project can stimulate public participation in community activities, redefine community governance, and give rise to a relational strategy that can generate the knowledge, distinctive competences, and collective capabilities that influence the direction of community development.”

### **Learning Management System - LMS**

This research has adopted the definition of an LMS by Ellis (2009, p 1):

“An LMS... is a software application that automates the administration, tracking, and reporting of training events. A robust LMS should be able to do the following:

- centralize and automate administration
- use self-service and self-guided services
- assemble and deliver learning content rapidly
- consolidate training initiatives on a scalable web-based platform
- support portability and standards
- personalize content and enable knowledge reuse.”

### **Managed Operating Environment - MOE**

MOE within this context refers specifically to the environment operated within all Queensland State Schools. The main objective of the Managed Operating Environment is to provide a standard operating environment for all state schools. This project intends to develop and implement the next version of the standard operating environments for servers and workstations. The proposed features and functions are:

- a proxy solution to facilitate local caching and reduce bandwidth usage
- automated patch management
- remote software deployment
- remote server administration
- enhanced wireless security through certificate and RADIUS services
- the latest anti-virus and spy ware protection (SAV10)
- regionally-based user accounts to enable cross-network access and facilitate secure, simplified sign-ons
- Microsoft Office Professional 2003
- an accredited training program for technical support staff, leading to the issue of the Orange Card. (Education Queensland, 2009b)

## **MOODLE**

MOODLE is a free software package for producing Internet-based courses and web sites.

“You are allowed to copy, use and modify Moodle provided that you agree to: provide the source to others; not modify or remove the original license and copyrights, and apply this same license to any derivative work” (MOODLE.org, 2008).

MOODLE can be installed on any computer that can run PHP (Personal Home Page) and can support an SQL type database (for example MySQL). It can be run on Windows and Mac operating systems and Linux derivatives (Red Hat or Debian GNU). It is the modular nature of this software that allows specific applications to be trialled within an individual site (MOODLE.org, 2008).

## **Microsoft Office Sharepoint Server - MOSS**

MOSS in this research context refers to the site-based intranet that can be incorporated within the local school community acting as an intranet. Intranets are similar to websites, but they are private and secure. They are used internally within organisations throughout the globe to communicate important information among employees (Education Queensland, 2007)

## **OneSchool**

The OneSchool program involves the design and deployment of a comprehensive, flexible and sustainable information management system in Queensland state schools. The OneSchool program is not just about securing a technology replacement for the current school-based system, but is concerned with delivering a comprehensive, flexible and sustainable information management system that will meet the future needs of the Department and schools (Education Queensland, 2009a).

## **Online communities**

Online communities are communities that feature electronically-based two way communication and often people identify with each other in discussing common issues.

## **Professional development**

Professional development is the practice of teachers maintaining or developing new skills. Professional development is facilitated for teachers from internal or external providers depending on need and expertise. It is critical to building the capacity, capability and sustainability of Education Queensland (EQ)’s workforce.

**Portal**

A portal is a website containing information about a community, generally created by either commercial or institutional organizations, with little input or opportunity for interaction by members of the broader community.

**RAID**

“A RAID 1 creates an exact copy (or mirror) of a set of data on two or more disks. This is useful when performance read or reliability is more important than data storage capacity. Such an array can only be as big as the smallest member disk” (Moodel.org 2008).

**Sakai**

Sakai is a free open source Learning Management System used by educational institutions or corporations. Sakai is a community of academic institutions, commercial organizations and individuals who work together to develop a common Collaboration and Learning Environment (CLE). The Sakai CLE is used for teaching, research and collaboration. Sakai is a Java-based, service-oriented application suite that is designed to be scalable, reliable, interoperable and extensible (Sakai.org, 2009).

**Sustainability**

Sustainability is the ability of an educational ecosystem to maintain scholastic processes, functions, diversity and productivity into the future (Vota, 2009).

**Sustainable Practice**

Sustainability in this context involves finding ways to support groups as they learn about technology, as they identify ways that technology can be used to address organizational and community level problems, and as they develop plans to take on projects involving technology (Merkel et al, 2005, p34)

**Virtual network**

A virtual network is a group of individuals that discuss common topics and through interactions may develop formal or informal networks. It is the social aggregations that emerge through the Internet when enough people carry on these public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace (Rheingold, 2002)

**Web 2.0**

The term Web 2.0 covers a range of technologies, services and trends underpinned by the growth of a critical mass of Internet users. It is about using the Internet as a platform for simple, light-weight services that leverage social interactions for communication, collaboration, and creating, remixing and sharing content. Typically, these services develop rapidly, often relying on a large community of users to create and add value to content or data. The availability and ease of use of Web 2.0 tools and services has lowered the barriers to production and distribution of content. Some examples of Web 2.0 services include: social networking sites, blogs, wiki's, social book marking, media sharing sites, rich Internet applications and web "mashups" (BECTA, 2008).

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## List of Abbreviations

EQ:	Education Queensland
BECTA:	British Educational Communications and Technology Agency
UNESCO:	United Nations Educational, Scientific and Cultural Organization
UDEP:	United Nations Environment Programme
OECD:	Organisation for Economic Cooperation and Development
MACER:	Ministerial Advisory Committee for Educational Renewal
ICT:	Information and communication technologies
LMS:	Learning management system
NDSHS:	Noosa District State High School

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Finally to my late father Peter “I kept my promise and completed.”

## **Declaration**

I declare that the work presented in this dissertation is to the best of my knowledge and belief, original, except as acknowledged in the text and that the material has not been submitted either in whole or in part for a degree at this or any other university.

The submission of this dissertation is in partial fulfilment of the requirements of the Doctor of Education at the Central Queensland University.

Greg Wilson

Maroochy River, Queensland

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# Chapter 1 - Introduction

## 1.1 Introduction: Towards a sustainable use of an LMS

Increasingly ICTs are permeating many aspects of our everyday lives and has influenced the ways we access and identify information, communicate and appropriate information to achieve daily tasks. There have been numerous meta-analyses of ICT initiatives world wide (OECD, 2007; BECTA, 2007) but there is relatively limited research into how individuals and communities benefit through the incorporation of ICTs and how this benefit of using ICT might become sustainable practice. This dissertation will use sustainable practice to mean ways that technology can be used to address organizational and community level problems, and how individuals and groups develop plans to take on projects involving technology. Internet-based ICT tools applied within education, business and government enable enhanced planning, networking and communication capabilities (BECTA, 2008). Networking as a social function has also developed and many people nowadays can form *social* relationships using these networking and other ICT technologies (BECTA, 2008).

Research in the UK has demonstrated that ICT skills applied within the educational setting require the development of national, state and localised strategies to embed these skills within teaching practice (BECTA, 2009). Doing so would seem to require discussion and professional development for all personnel within schools with a target of reconciling traditional mindsets of current teachers (Yarnit, 2000; Sévigny & Prévost, 2006; Hennessy & Deaney, 2004). In the context of this research, Education Queensland (EQ) has challenged schools to respond to the technological advances identified within the Smart State framework (Education Queensland, 2009) and redefine current school practice to incorporate new technologies that help develop sustainable educational systems (Education Queensland, 2006c). Responding to this challenge requires schools to deliver flexible solutions that improve learning outcomes for students yet enable development of improved technical skills for teachers demanded within this context.

This research examines the implementation of a Learning Management System (LMS), Modular Object Oriented Dynamic Learning Environment (MOODLE), at a large semi-rural high school on the Queensland Sunshine Coast. (Noosa District State High School)

The implementation of MOODLE was undertaken at this school as a major initiative to addresses the key ICT objectives and community engagement outlined under Queensland Government

Smart State policy (2007) as outlined above. This research, in addition to answering the research questions listed towards the end of this chapter, will document the steps taken in the implementation of MOODLE, explore the effects of MOODLE on the school's teaching and student communities, and describe changes to teaching practices that occurred in helping develop a wider understanding of sustainable ICTs communities and resultant benefits for a school and its community.

This chapter will also outline the issues that led to this research being undertaken, presents a justification of the research, its significance and its limitations. The aim of the research, research questions and objectives are then stated and an overview of the content of the chapters within this dissertation is provided.

## **1.2 Background**

The Queensland Government has detailed a position for Queensland as the Smart State by stating: "The Smart State Strategy is the Queensland Government's signature policy; promoting a state where knowledge, creativity and innovation can flourish:" (Queensland Government, 2008, p.1). Government departments have aligned operational policies with the vision of this framework. The use of ICTs is a cornerstone for the Smart State agenda and this is acknowledged within EQ's core ICT policy: the Information and Knowledge Strategic Plan 2007 – 2011 (Education Queensland, 2007c). This document outlines the key vision for schools incorporating ICTs for administration and learning. Included within this document are key objectives for schools concerning "transformations and sustainability" (Queensland Government, 2007c, p. 2). These core concepts, transformations and sustainability are considered in chapter 2 of this dissertation, the literature review. The remainder of this section provides a background concerning the use of ICTs in schools as promulgated by EQ and the notion of sustainable ICT practices in schools and how this may be delivered within a school site.

### **1.2.1 The Internet in schools and facilitation of ICT school networks**

The conditions that established this research require an explanation of the current connectivity for school ICT facilities. Presently a majority of EQ schools operate standard Telstra Internet connections in the range of 1.5MB/sec download and 512KB/sec for upload. With large traffic volumes at peak student usage, loads can affect Internet delivery speed into classrooms and may hamper lesson effectiveness. Often slow Internet delivery speeds cause students and teachers to be frustrated. Therefore file sizes and e-traffic, which can cause slower Internet speeds, have

become an issue in accessing *offsite* web-based content, i.e. web content that is not on the local school site.

Some Internet services in schools are provided by EQ through *The Learning Place* (Education Queensland, 2007b). This portal, established by EQ, operates from Brisbane and schools can choose to access on-line courses extending the use of ICT applications for their students. In this context, access to on-line courses is a *key* objective identified as a strategy to transform learning experiences for students (Education Queensland, 2007). Through this portal, schools have access to the Blackboard LMS as a standard operating framework for EQ schools. To aid users of *The Learning Place*, EQ has implemented a range of training projects (Education Queensland, 2006c) that teachers and school technicians can access.

Using the policy guidelines set down by EQ, Noosa District State High School (NDSHS), decided to implement a LMS. A major consideration in the choice of deploying an LMS was Internet delivery speed. Accessing an offsite portal as offered through the Learning Place is reliant on the current bandwidth provision limits and this potentially can reduce the effectiveness of LMS use through a reduction in speed due to traffic loads within the school network. Further LMS features that allow data transfers as an upload can be slow due to the small upload speed.

In fact EQ has identified a number of challenges associated with the delivery of ICT to schools. These include “teaching staff skills, bandwidth, upload limits and technician skills contained within a school site” (Education Queensland, 2006c p. 2). These challenges have the potential to limit the scope for a school to operate their own infrastructure especially in a non-urban school, where Internet delivery can be slow, such as NDSHS.

Currently, EQ schools are not permitted to operate site-based portals using a non-approved Internet connection (Education Queensland, 2006c). Costs associated with upgrading to faster speeds are borne by the schools and often are prohibitively expensive. This creates reliance upon the Internet delivery speeds through the EQ network supplied by Telstra, which necessitates a restriction upon file sizes and types that can be downloaded and uploaded. Thus using EQ delivery with the offsite LMS Blackboard and EQ Internet connection becomes a major issue for all schools, such as NDSHS.

Key initiatives being deployed to standardise EQ's corporate ICT structures include OneSchool (Education Queensland, 2006b), the Managed Operating Environment (Education Queensland, 2006a), and Microsoft Office SharePoint Server (Education Queensland, 2007). Each of these initiatives intends to help deliver EQ's vision of a connected ICTs community that operates across the State. In light of the foregoing, the school site in this research obtained permission from EQ to operate a site-based LMS. The implementation and operation of MOODLE forms the basis of this study.

### **1.2.2 Education Queensland ICT policy and classroom ICT practices**

Transforming teacher practice using ICTs is a central theme identified within current EQ policies (Education Queensland, 2007b; 2007c). Actioning policy initiatives have required the introduction of activities that help achieve the delivery of this vision. In this respect EQ has developed the Smart Classrooms (2007b) framework to focus its ICTs development strategy for EQ schools. To support teachers EQ has provided The Learning Place using Blackboard as the LMS as the state-operated web portal supported centrally by EQ. In order to develop site-based ICT capability, school sites need an extension of the ICT functionality currently provided, locating ICT practices within schools.

EQ policies (EQ, 2006a, 2007a) identify teachers working with technology as crucial to addressing the EQ ICT initiatives in developing sustainable site-based practices. Such practices necessitate development of the human and physical resources within a school site specifically improved shared practices. For instance, Hennessy and Deaney (2004) in their research of teacher work practice in the use of ICT by secondary teachers in the UK observed that teachers,

...do not generally work alone; the subject department acts as a 'community of practice' (Lave and Wenger, 1991), sharing resources, approaches, cultural values and aims, and collaboratively-developed schemes of work (p. 1).

Hennessy and Deaney (2004) reported that teachers need to develop relationships surrounding ICT that help support teaching practice within the school. These relationships are explored within chapter 2, the literature review, and concern the attributes and conditions necessary to support change. One consistent theme in describing *ICT sustainability* is the concept of individuals working together toward the improvement of the site globally.

The remainder of this chapter outlines the current policy initiatives governing ICT facilitation within EQ within the school context.

### **1.2.3 Sustainable ICT practices in schooling**

This research concerns an exploration of the sustainable use of the MOODLE LMS at a school site. As considered in chapter 2, sustainability is a complex concept and needs school site development that is multi-faceted (Education Queensland, 2007b). Sustainability as identified within broad EQ policy initiatives recognises the need to incorporate sustainability principles within a school's ICT community. Literature (OECD, 2007; BECTA, 2007) suggests supporting practice within a school site helps develop sustainability.

EQ's view of sustainability is a differing view concerning sustainability:

Smart Classrooms will deliver an expanded package of ICT support and access, lessening the burden on schools in delivering these services and clarifying responsibilities for asset maintenance and renewal. The use of school ICT must be maximised to take best advantage of the department's extensive ICT investment. Smart Classrooms will provide schools with 24-hours-a-day, seven-days-a-week electronic access to much of the department's ICT infrastructure sparking greater and smarter use. (Education Queensland, 2007c, p.2)

According to EQ, ICT practice that enables and improves teaching practices in classrooms should help to develop the overall capacity of that site (EQ, 2007b). Such ICT practice should develop sustainable practices within schools. As documented within the literature (OECD, 2007; BECTA, 2006) sustainability also needs to include goals that focus upon the actions of its participants.

These include:

- participants find a way to sustain the production and sharing of resources;
- participants must find a way to sustain the use and reuse of their resources they develop;
- participants should engage in wider networks outside their scope developing links to help sustain development. (OECD, 2007, p. 89)

Ballantyne (2003) notes that the importance of sustainability cannot be understated as the value of the initiative in this case, ICT, must reflect a value and a benefit for the site. He argues "the local stakeholders must be committed to an activity and have a sense of ownership of it, as evidenced by their taking on responsibilities for the activity and its outcomes" (Ballantyne, 2003, p. 1).

The approach to sustainability adopted by this school site incorporated additional aspects of sustainability derived from the literature as presented in chapter 2, to inform and develop a whole of school LMS approach.

#### **1.2.4 Sustainable practices using an LMS in schools**

According to a number of studies (BECTA, 2008; Hennessy & Deaney, 2004) it is the local level where work in developing sustainable practice has to occur. In this respect embedding an LMS as a school's intranet is identified as a means for allowing a common framework that can improve a sites approach in establishing ICT practice (Education Queensland, 2007b). The development of sustainable practice requires a consistent platform, such as MOODLE that is supported coherently into the future, and has the possibility for future development. This allows for participants within the site to change and modify modules and plugins available within the LMS. Doing so allows for discussion about the usefulness of the LMS with students and peers allowing for interactions that may enable sustainable ICT practices to develop.

#### **1.3 Aim of the research**

The aim of this research is to describe and analyse the implementation of MOODLE in a large high school setting and the documentation of the aspects that develop and support sustainable ICT practice. The sub-aims addressed in this research are:

- to examine student and teacher perceptions of the use of and incorporation of MOODLE into classroom practice;
- to identify ICT applications associated with the use of MOODLE by teachers and students that embed ICTs into classroom learning;
- to explore the critical technical considerations for establishing a school-based web portal;
- to identify factors that enhance the uptake of MOODLE that contributes to the development of sustainability.

#### **1.4 Research questions**

The above aim is addressed using the following research questions (RQs):

**RQ 1** *What are the critical considerations in the implementation of a sustainable LMS in a school community?*

RQ 1.1 What factors encourage participation by staff and students in a site-based community?

RQ 1.2 What changes occur in teaching practice(s) with particular reference to the development of sustainable use of ICTs supporting pedagogical practices within the classroom?

RQ 1.3 How can the results of the research be used to develop a set of guidelines for the sustainable use of a MOODLE LMS in a school?

***RQ 2 What are the critical developmental and operational parameters needed in the establishment of a sustainable site-based LMS?***

RQ 2.1 What technical requirements are needed to establish a site-based community?

RQ 2.2 What functionality features can increase the use of LMS for student, teachers and administrators in a site-based community?

***RQ 3 What features of an LMS contribute to its sustainable use?***

RQ 3.1 What aspects of MOODLE can increase ownership and use of the resources for students and teachers that identify sustainable e-learning practices?

RQ 3.2 Can MOODLE stimulate the use of other ICT development, enhancing an e-classroom?

## **1.5 Research objectives**

The research objectives used in order to explore above RQs are as follows:

- Examine the research literature to define the term sustainability as applied in a school community context that uses ICTs. This definition is required to provide a basis for addressing the research questions RQ1.1, RQ1.2, RQ 3.1.
- Undertake a review of the literature to identify the research in the area of LMS and their operation in the delivery of online courses with particular reference to their use in schools. This review intends to identify the organisational structures that support embedding ICTs within the classroom. (RQ1.3, RQ2.1)
- Undertake case study research to document student and teacher use and perceptions of using MOODLE in the school community. (RQ 2.1, RQ 2.2)
- Based on the analysis of the data from the case study research, develop a set of guidelines to implement a web portal. (RQ 2.1, RQ 2.2)
- Document the changes in classroom practices that can occur using an LMS that influence *ownership* of online courses that engage both teacher and student in sustainable practices. (RQ 1.2, RQ 2.1, RQ 3.1, 3.2)

- Document the technical and operational parameters that will enable sustainable use of MOODLE at this site. (RQ 2.1, RQ 2.2)

## **1.6 Rationale and significance of the research**

As will be shown in chapter 2, sustainability research (Angelo, 2000; Education Queensland, 2006a, 2007c; BECTA, 2007; OECD, 2007) provides insights into how initial enthusiasm of establishing a LMS can be maintained, and how teacher and student practice changes over time in response to the provision of an LMS. The literature (e.g. Hennessy & Deaney, 2004; Ripamonti, de Cindio & Benassi, 2005) describes these changes as organisational transformations affecting individuals and adding value to the whole site. Organisational transformations according to Hennessy and Deaney (2004) require focus on the changes that occur within the classroom planning models within schools. In this case it will also require consideration of accessibility in EQ's OneSchool security.

Achieving these transformations will necessitate consideration of the technical management of the LMS; a focus upon how to implement the LMS and the associated influence upon teachers' pedagogy and finally, the resultant effect upon the engagement of students using ICTs that access this LMS (BECTA, 2008).

An overview of the literature found that there is limited documented peer reviewed research regarding the sustainable use of an LMS in schools. Preliminary examination of the literature concerning the use of LMS in schools appears to concern implementation of LMS within the tertiary sector. Within most current documentation, few studies were found that applied to the school sector. Furthermore, most of the research is from the UK and the USA, hence a need for research in the area in an Australian context.

This research is significant as it seeks to:

- document the evaluation tools used to select an LMS in this research;
- provide technical data needed in the implementation of an LMS at a school site;
- describe the conditions required for teachers as leaders enhancing the understanding of web portals and their operational and organisational impact upon a schools culture;
- describe networks established within the school site that contribute to developing sustainable ICT practices.

In addition, this research is significant, as it will develop a set of guidelines for schools in operating a portal.

### **1.7 Scope and limitations**

The data obtained in this research has used a case study methodology (Yin, 2007). Data has been gathered from:

- Individuals who chose to participate in a site-based community established at the school site.
- Technical data gathered using data logs contained within MOODLE.
- The features of the LMS under research, MOODLE. Being an open source product modules and plugins can change with new features being embedded or altered based upon community need.

Thus the research has the following specific limitations:

- The research is confined to one educational site, a secondary school. Thus the findings represent a learning community within this context.
- The research does not consider the view of parents or the overall impact of MOODLE on the school community.
- The research concentrates only on ICT use in one secondary school. The results of the investigation will thus be specific to the use of ICTs in this secondary school.
- The data collected from the interviews, observations and statistics will be limited to the views of participants from this school.

### **1.8 Organisation of dissertation**

The chapter structure for this dissertation is as follows:

#### **Chapter 1 – Introduction**

This chapter introduces the nature of research topic, define its scope and outlines the significance and rationale for undertaking this research. The aims, objectives and research questions are presented. The chapter concludes with an outline of the structure of the thesis.

#### **Chapter 2 – MOODLE at Noosa District State High School**

This chapter concerns the implementation phases for the LMS at this school site. It describes the conditions present that led to the establishment of MOODLE at this site. Further, this chapter documents the hardware and software packages needed for operating an LMS and examines the configuration of these packages to establish a secure site-based web portal.

**Chapter 3 – Literature Review**

This chapter develops the research context through a discussion of the literature concerning the practice of using LMS structures within schools and issues that are important in the development of sustainable site-based ICT practice. Key concepts developed from the discussion help identify concepts for developing sustainable practice within schools and also as a design for the research.

**Chapter 4 – Research Methodology**

This chapter details the methods and data collection tools used to examine the stated research questions.

**Chapter 5 – Results and Discussion**

This chapter is devoted to the description of the data collected. Results are presented as evidence of the action phases for this research.

**Chapter 6 – Conclusions and Recommendations**

This chapter presents the findings of the research, its implications and concludes with recommendations for establishing a site-based LMS. Emergent themes from the analysis phase are synthesised into a set of guiding factors that help develop a sustainable LMS architecture within an EQ schools. A set of guidelines for developing a site-based MOODLE LMS will be included in the recommendations.

# Chapter 2 – MOODLE at Noosa District State High School

## 2.1 Introduction

This chapter describes the school setting in which this research took place and the implementation of MOODLE at Noosa District State High School (NDSHS). It begins with a description of the school environment and the formulation of the approach used in the implementation of MOODLE. Figure 2.1 presents the research phases used in the implementation of MOODLE at the school.

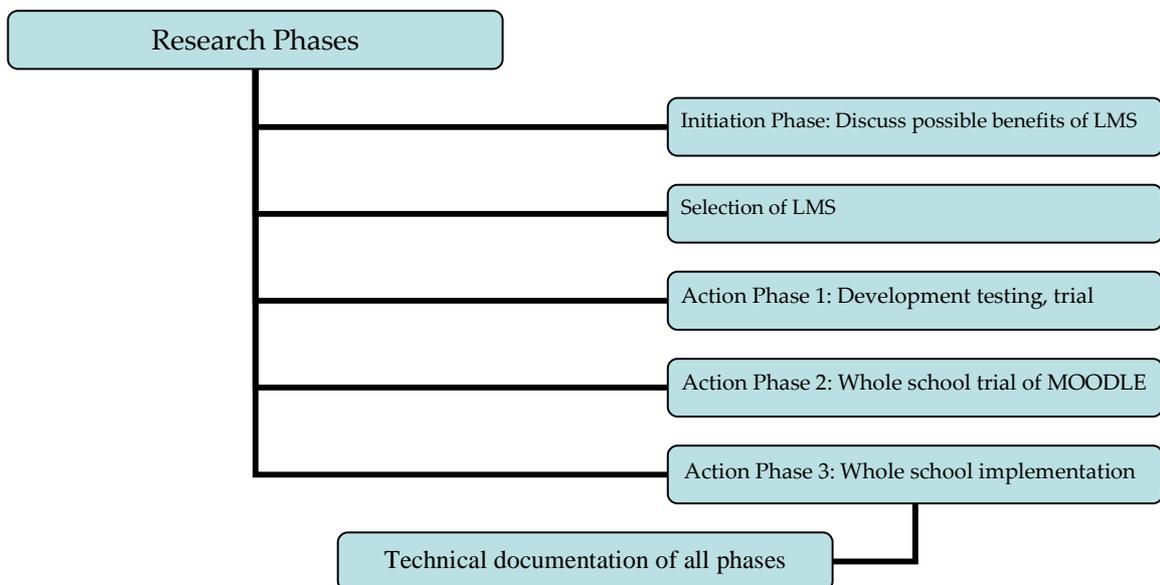


Figure 2.1 Research phases

In each phase data was collected to help inform the design of the ensuing phases. Documentation of the technical aspects of MOODLE was part of the research diary notes and covered each of the phases.

This chapter then outlines the background for these discussions that concern aspects of sustainability and how these discussions were used to guide development of strategies for implementing MOODLE. The final section provides an outline of the technical requirements used at this time for the implementation of MOODLE.

## 2.2 Description of Noosa District State High School (NDSHS)

### 2.2.1 Background

NDSHS was established in 1963 in the town of Cooroy in Queensland, Australia. This location services the high school needs of Cooroy, Eumundi and Pomona districts as well as the coastal areas of Tewantin and Noosaville. The school's catchment area is a growing population area, with considerable residential development in the Cooroy and Pomona areas and with a substantial migration of people into and out of the area. The community consists of people with a wide range of occupations and interests. Destination studies by the school (NDSHS, 2008) show most students after completion of the final year of school are employed in the service industries associated with the hospitality, tourism and retirement industries. Other students choose to undertake further tertiary study. In the hinterland, people engage in rural production of fruit, small crops or cattle. This location also has many families who are self-employed, having left more traditional employment in the cities, however many of the residents also travel to other areas of the Sunshine Coast for the purpose of employment.

Table 2.1 below, shows the total school enrolment for the period 2005 -2009. The table shows that Noosa District SHS has a comparatively stable student enrolment and teacher numbers during this period have also been stable, as have been the allocation of administrators for this school.

Table 2.1

*Noosa District State High School*

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Year	Students	Teachers	Heads of Departments	Senior Administration	Ancillary Staff
2005	1244	104	13	5	21
2006	1252	105	14	5	21
2007	1238	105	14	5	21
2008	1246	105	14	5	21
2009	1288	108	14	5	21

Noosa District SHS operates two campuses, the main campus is located in Cooroy and a second campus is at Pomona, 14km from Cooroy. Students that attend these sites are drawn from five feeder primary schools within the region. In 2009, Noosa District SHS had twenty-eight students identified as either Aboriginal or Torres Strait Islander and less than one half of a percent of our

students speak a language other than English at home. Fifty-nine students have been formally ascertained, under criteria specified by EQ, as requiring specialist teacher support and teacher aide support in class and are based in a Special Education Unit. All of these students are integrated into some mainstream classes and are on Individual Education Programs (IEPs) to cater for their education needs.

### **2.2.2 School goals**

Noosa District State High School sets two educational goals for its students:

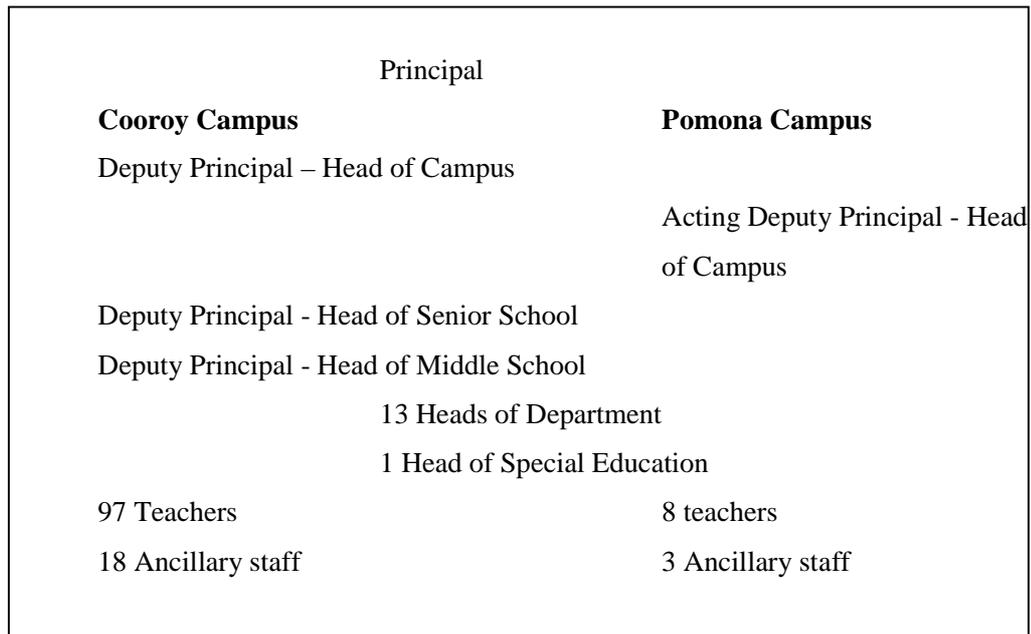
- to promote equity and excellence
- become successful learners, confident and creative individuals, and active and informed citizens.

These school goals are located within school policies and procedures and act as overarching considerations for school committees.

### **2.2.3 School staff profile 2006 - 2009**

The majority of staff employed at this school site has taught for more than 18 years in a variety of school locations around Queensland. These teachers, having previously done country service have applied to transfer into NDSHS often for the remainder of their careers. Consequently there is a relatively low turnover of teachers and many teachers have taught at this school for an extended length of time. The average length of time teachers have spent at NDSHS is 14.3 years.

The school administrative structure is presented in Figure 2.2. It can be seen that the school has a total teaching and admin staff of 148 personnel. The Principal is located at the Cooroy campus but acts across two separate campuses some fourteen kilometres apart. Each site has one or more Deputy Principal and the Heads of Departments operate across both campuses.



*Figure 2.2* School administrative and staffing structures

The teaching staff also provides a range of activities outside the required curriculum with this reflected through the extra curricular activities such as sport, debating, drama, equestrian and cattle. There is a demonstrated commitment by staff to participate in a broad range of school activities and to serve on school committees, for example, the School Renewal Committee. Students also serve on student representative committees.

Figure 2.3 shows the committee structure that operates at this school site. It can be seen that the committee structure has a hierarchical reporting structure.

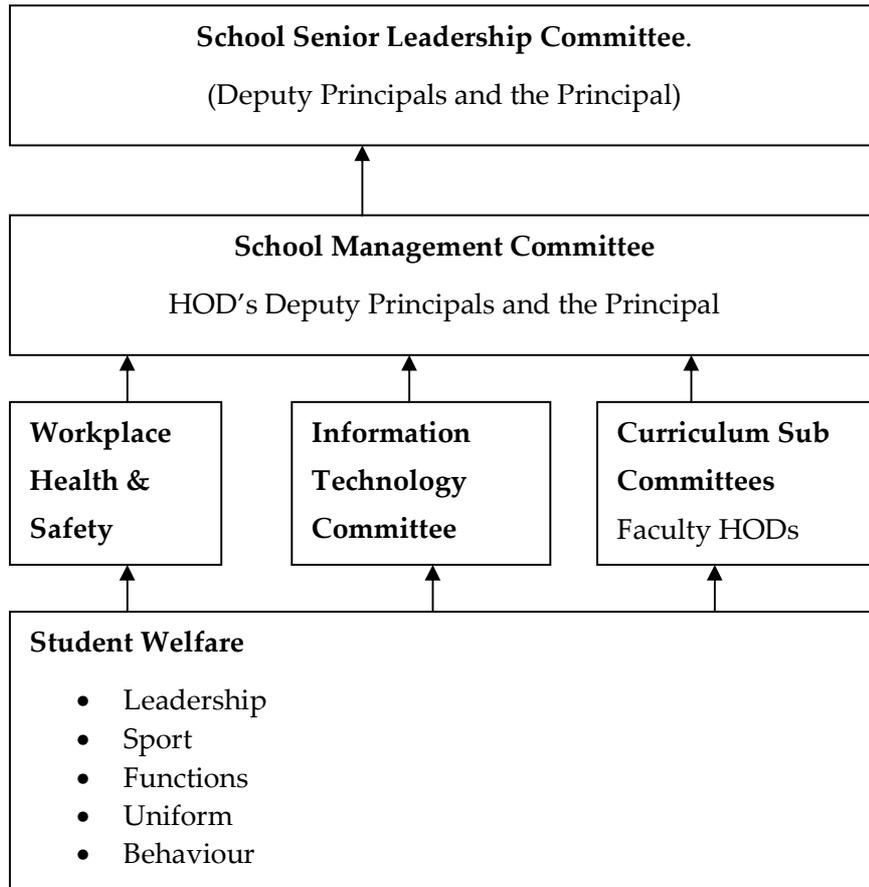


Figure 2.3 School management committees

## 2.3 Genesis and implementation of MOODLE at NDSHS

Chapter 3, the literature review, considers the context and changing nature of secondary schools for the adoption and use of ICTs. This exploration provides a backdrop and rationale for the adoption of MOODLE at NDSHS. Central to adopting MOODLE was creating an ICT environment that was *sustainable*. The review undertaken in chapter 3 identifies a *gap* in the literature concerning sustainable use of ICTs for teachers using ICTs with their students.

### 2.3.1 Introduction

Early February 2005, Noosa District SHS student enrolments had increased above 1240. EQ indicated the school was now eligible for a thirteenth Head of Department. In discussion with Sunshine Coast District Office, the Principal sought to establish a new faculty to be called *Student Services*. It was decided by the School Leadership Committee that the role of HOD of this faculty

would be primarily to work with teachers and curriculum HODs concerning teacher practice within classrooms and promoting non-punitive strategies for behaviour management.

The new position of the *HOD Student Services* enabled the scope for wide discussions with teachers about working with disengaged students, (evidenced by inappropriate behaviour) and identifying and trialling alternate classroom approaches. These discussions also included supporting staff in developing strategies for differentiating learning for all students within classes and especially those who exhibited challenging behaviours. The decision to create a Student Services faculty was influenced by survey data collected in February 2005 (Noosa District SHS, 2005) and other school data. This data identified a core group of students causing disruption to classes across a range of subject areas. This data included:

- Behaviour management records sourced from the schools data base.
- Academic results obtained in the student database.
- Teacher anecdotal records identifying disengaged students that were disrupting students learning.
- Notes from parent meetings

Therefore a new HOD for the Student Services faculty was appointed in January 2006.

At the same time the school ICT technician had returned from an IT trade show in Melbourne with a range of school-based IT products, one of which was MOODLE. Discussions and an evaluation of differing LMS applications occurred. This was informed by the evaluation of a selection of LMS platforms as discussed in chapter 3. MOODLE, Blackboard and Sakai were discussed at this meeting and features of each were presented. This presentation also included a working demonstration of each LMS and the features they contained.

This research identified MOODLE as the preferred LMS. This decision between the HOD Student Services and the ICT technician about the use of MOODLE led to a submission by the researcher to the Principal for a trial of MOODLE with a group of selected students. MOODLE was selected as a way of dealing with the selected disruptive students, as anecdotal notes from behaviour management records noted students wanted a *say* in their learning. MOODLE was identified as students could have a choice in the selection of modules and plugins active within the online courses. Work by Ballantyne (2003) suggests that participants afforded the opportunity of choice may lead to the development of a sense of *governance*. This aspect was considered important in the design of this research as a goal of this initial trial was the students' improvement in behaviour and engagement through the use of MOODLE as a learning tool.

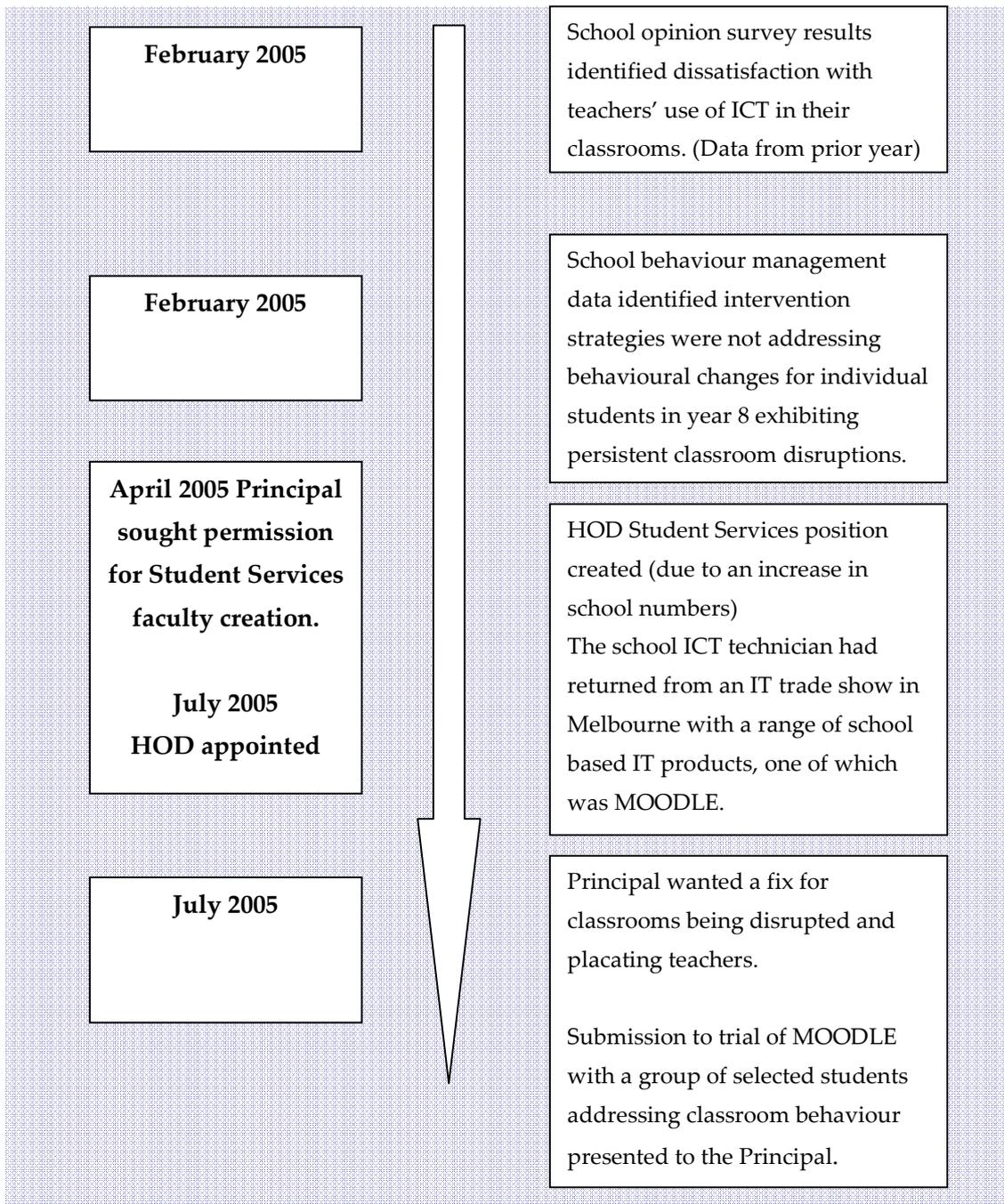


Figure 2.4. The genesis of MOODLE at Noosa District State High School

It was recommended that this submission be presented to the School Management Committee. The timeline of events that led to the appointment of the HOD Student Services and the introduction of MOODLE to the school community is represented in Figure 2.4 and illustrates the events that led to the creation of the Student Services Faculty.

The Student Services Faculty sought permission from the principal to develop a special program for these students incorporating the use of MOODLE, still allowing students to continue their educational program. A group of seventeen year 8 students were identified as *at risk* of not completing to year 10 levels. Letters were sent to parents / guardians to come to an interview that outlined an alternate approach using ICT as a “latch” for students to re-engage them into the classroom. Following the interview process, fourteen students nominated to participate in a trial that focussed upon them using MOODLE to co-design their learning environment.

The initial interview process with students identified a common theme. All students had become *bored* within classes after a period of between 15 – 20 minutes. This may not be uncommon, but the behaviours of these students demonstrated an inability to refocus on class work when directed by the teachers. This above behavioural trait appeared common across all subject areas for these students and behaviour management data identified similar *exit* times from class. The academic performance of this group of students is presented in chapter 5 and details the academic data from Action Phase 1 noting some changes within this cohort at the end of the trial phase that enabled the implementation of MOODLE.

In order to address the frequent student disengagement, a learning management system MOODLE was incorporated into their learning environment. In this respect permission was granted from EQ at the beginning of the trial for a trial web portal to be established for these students.

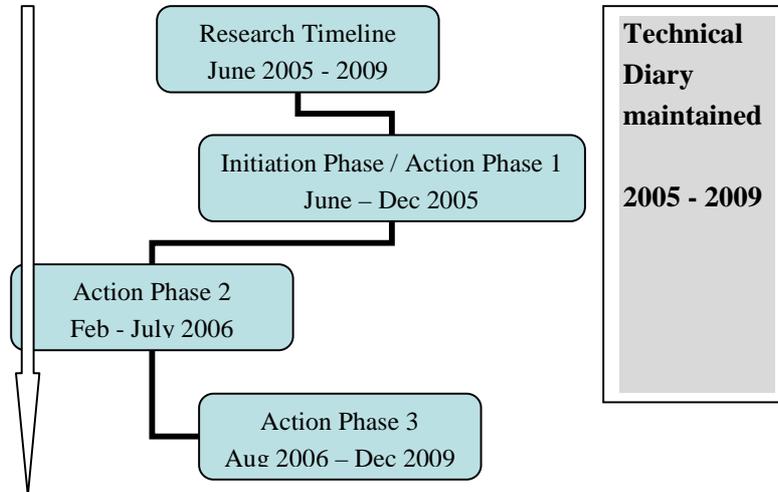


Figure 2.5 Research Timeline

### 2.3.2 Initial trial use of MOODLE with small cohort of students, Initiation Phase and Action Phase 1

The above set of events resulted in an initial trial of MOODLE as indicated in Figure 2.4. This trial was considered to help address student attendance problems and to give these students greater control in the selection and sequencing of their learning tasks. MOODLE is an Open source platform which allows for modules and plugins to be added or removed based upon the needs of the users. This ability to tailor the LMS appealed to the teacher participating in this phase as this feature supported the strategy for students to develop ownership (Ballantyne, 2003) for course design and resource selection. It was for this reason the platform MOODLE was chosen as it allowed the teacher and students the ability to co-design their online courses.

Classes occurred in the one room and students were given ownership of the room by displaying their own works/assignments and being allowed to put up one favourite, appropriate poster. The room was different from traditional classrooms at this site as the room had 8 networked computers. This room configuration allowed for targeted strategies involving technology to impact on the students' engagement within school and elicits students' commitment to the new program.

These students undertook an individualised course of study-based on core subjects, Math, Science, English and SOSE, under the guidance of one lead teacher (HOD Student Services). Other teachers provided afternoon access to alternate support activities. One teacher aide was allocated to support the students, with the onus being on the students to seek assistance as required. Students were encouraged to be involved in the online building of the initial courses as a means to getting them involved in and to take ownership of their learning. Students were also encouraged to access web-based applications they found enjoyable or useful in helping them access content.

At the conclusion of this trial, data was gathered from academic records, behaviour data, and notes made through interviews by Student Services staff with students. These results of this trial are presented in chapter 5. The results obtained demonstrated students did re-engage in learning as evidenced from data logs, under the approach that was adopted. Results also demonstrated that attendance for this trial cohort also improved. It was decided by the Student Services HOD to then present this information to the School Management Committee with a view to extending this trial within the wider school community. The presentation had the goal of getting the support of the school leadership committee. Teachers from faculties were then invited to undergo training in the use of MOODLE and access teacher aide support in developing courses for “mainstream” classes.

### **2.3.3 Extension of the trial use of MOODLE – Action Phase 1**

A proposal for the extension of this trial use of MOODLE was presented and approved by the School Management Committee to evaluate the following:

- Technical trials and discussions with the HOD Student Services to determine the location and configuration of the classroom design for the trial (Action Phase 1).
- Examining room layouts for the inclusion of ICT by providing students their own room equipped with a computer ratio of 1:2. The decision incorporated factors such as technical support based at the site, costs associated with set up and maintenance.
- Identifying site-based models for professional development.

The extended trial involved inviting teachers from faculties to undertake training in the development of online courses. Teachers were also given access to notes from the initial trial and discussions helped frame the development of material to be used in classes. Part of this process was to involve students in determining the features incorporated into courses and the “usefulness”

for them as students. This was measured using data logs and statistics available within MOODLE and through focus groups. The outcomes of this extended trial resulted in the School Leadership Committee to select MOODLE as an LMS platform. This decision was determined from the LMS evaluation criteria described by Alvarado and BECTA and from focus group responses. As described in chapter 3, MOODLE offered a range of technical features and support for modules and plugins. The School Management Committee endorsed this decision to implement MOODLE as a site-based LMS. The decision to develop a site-based model was identified as preferable but a key aspect identified in the development of this model was to make its inclusion sustainable. This aspect was undertaken by the HOD Student Services and became a research project concerning sustainability for EQ and as part of study with CQU.

### **2.3.4 Whole scale implementation of MOODLE at NDSHS – Action Phase 2**

A number of concomitant changes occurred as a result of trial use of MOODLE at NDSHS.

These were due in part to the following actions:

- Professional development for teachers concerning technical development of MOODLE courses.
- Training of teacher aides was undertaken so they could convert existing exams into online exams for use within MOODLE.
- Identification of more teachers willing to adopt MOODLE.
- Using students to trial modules and plugins. Feedback from these students helped to modify courses within MOODLE and adjust functions offered.

These aspects are considered in detail in the remainder of this section:

## **2.4 Features of the implementation of MOODLE**

### **2.4.1 Introduction**

The School Opinion Survey (NDSHS, 2005) identified teachers wanting to integrate technology within their classroom for teaching tasks and assessment tasks. As a consequence, this led to the decision to facilitate a school-based solution in response to the staff and students dissatisfaction with ICT delivery and functionality within this school (NDSHS, 2005). The implementation of MOODLE afforded the opportunity for staff to trial and to use a range of ICT applications within their classroom. MOODLE was selected as its features allow both students and teachers to access digital material. It also offers teachers administrative functions helping improve work practices involving communication and administrative.

### **2.4.2 Professional development.**

Initially MOODLE professional development targeted one or two staff members from each staffroom. This strategy was designed using recommendations identified in Chapter 5. In particular, research by BECTA (2009) was used for the implementation of courses across all faculty areas. Initially groups of teachers from all the faculties collaborated to identify which courses students accessed most and establish common features used across a range of subjects. Doing so helped to establish a number of MOODLE courses and resulted in the development of teacher mentors from a range of faculties.

Professional development was also offered as a series of after school workshops for teachers to share resource ideas and skills based on the MOODLE features being accessed and used often by students. These workshops enabled teachers to feel more confident in their ability to use MOODLE and helped to stimulate conversations about MOODLE applications used within classrooms. A number of teachers who had regularly attended these workshops offered to mentor other teachers and explore incorporating other features of MOODLE into their classroom.

To facilitate this resource development for MOODLE, a teacher aide involved in the initial trial phase was released from other teacher aide duties to support teachers wanting to develop online resources.

### **2.4.3 Teacher aide MOODLE training**

Discussion at these MOODLE features workshops between teacher users also identified training as an important aspect. This was deemed essential by the school leadership committee in helping to develop digital resources for use within MOODLE.

The support teacher aide for MOODLE became a 0.5 full time position in February 2006 and was funded by the school. The 3 teacher aides located within the office that traditionally prepare exams or worksheets, were offered training in converting existing resources into online versions. This training of the teacher aides was undertaken by the HOD Student Services. This training focussed on:

- Converting existing text-based resources into digital formats.
- Focussed on the production of embedding video resources into online applications.
- Developing quiz material contained within MOODLE.
- Linking web-based resources within MOODLE.

This training and the initial trial provided resulted in the development of four aides that staff could access to support development of electronic resources for inclusion within MOODLE.

#### **2.4.4 Recruitment of teachers willing to adopt MOODLE**

Teachers were invited to a presentation of results mentioned in section 2.3, and observations of data gathered during the extension of the trial. At the completion of the presentation, staff were asked to register their interest in using MOODLE for their classroom practice. Prior to Action Phase 1, commencing teachers were asked to volunteer to undertake training in the use of MOODLE. These teachers formed the initial cohort of staff who used MOODLE and many of these teachers became mentors. The above process was repeated at the end of each Action Phase to promote the use of MOODLE and increase the total number of staff using MOODLE.

#### **2.4.5 Use of student responses to define and refine MOODLE features**

The importance of using student feedback in helping decide on features used within the classroom is identified in teacher workshops and focus group sessions as outlined in chapter 4. The initial trial of MOODLE established that students liked the ability to help select and design resources like blogs and chat room, used within MOODLE. Focus groups and research diary notes were used to collect responses from students and teachers. This information was shared with students helping them with decisions concerning modules and plugins selections and evaluating the usefulness of activities contained within MOODLE.

In addition, a group of students who were a separate computer class made up of self nominated students met in school time on a Thursday afternoon. This small group of students accessed the school technician and trialed modules and plugins informing administrators of their use and potential benefit for classes. This aspect is further documented in chapter 5.

### **2.5 Administration, technical description and characteristics of MOODLE use at NDSHS**

#### **2.5.1 Introduction**

The configuration for the MOODLE operation necessitated a consideration of a number of areas – hardware, connectivity to the Internet, speed, operational security and the operating system. These requirements needed to take into consideration Education Queensland guidelines regarding security of the corporate network (Education Queensland, 2007c) and incorporate installation

advice from MOODLE (MOODLE, 2008). The remainder of this section considers these aspects regarding the implementation of MOODLE at NDSHS.

## **2.5.2 The MOODLE site at NDSHS**

MOODLE operates as a web portal (See Chapter 1, Section 1.3). The site manager for this web portal is the school technician responsible for maintaining the school network. The web portal allows teachers and students to access online content both inside the school and after hours. This feature has enabled the expansion of a range of applications that include access to booking software allowing teachers to book rooms or equipment items from home, streaming video news bulletins or promotional material in a digital format to parents. These features have stimulated teacher and student action around developing digital material and importantly organising this content into meaningful activities for learning. A result of this technical development is the impact upon curriculum development that includes ICTs. One example, like school video news has developed into cross-faculty projects that incorporate a range of learning and assessment tasks.

## **2.5.3 Management of technical aspects of MOODLE**

### **2.5.3.1 Introduction**

EQ has mandated that under the MOE that technical work on servers of the network be restricted to “Orange Card” (OC) holders. Becoming an OC requires technical staff to study prescribed MOE settings and technical functions before sitting a formal online exam. Consequently all work within schools must be completed by OC holders. The MOE system also has a number of permission levels within it reflecting the hierarchy of technicians.

Management of technical aspects within the school network at both campus sites is restricted to the school technician and a teacher with an Orange Card (OC) who is a backup when needed. EQ requires site-based OC holders to have sole access to network applications and security settings. Teachers however can access MOODLE.org to identify modules and plugins that users may wish to try. The school technician usually installs the module or plugins and provides a hyperlink to documentation for use. Installation instructions for MOODLE that were used at this site are attached as Appendix A.

### **2.5.3.2 Hardware**

Based on research into server configurations it was decided by the IT Committee in 2006 to purchase a RAID 1 server in order to deliver a fast, reliable and robust service for MOODLE still within the allocated school IT budget. This server has dual Xeon processors, 4 GB RAM and three large hard drives in a RAID 1 configuration affording a configuration supporting the provision of an LMS.

Two drives are linked in a RAID 1 (mirrored) configuration which allows for one drive to fail without bringing the system down or losing data. The failed drive can be swapped with a replacement which is automatically rebuilt by the system without down time. The RAID 1 configuration provides a margin of safety being able to still operate if one drive fails. This helps to prevent data being lost and replacement drives can be installed at a minimal cost. The third drive in the system configuration is used as an internal backup drive. This backup without downtime, is an essential element of the sustainability of the LMS.

There are other RAID configurations such as RAID 5 which require more disks and which would (arguably) give better security. These options were rejected as too costly by the school's IT Committee.

### **2.5.3.3 Operating system**

Two main contenders for an operating system were identified by the school OC holders, as Windows and Linux. Windows is a closed source, proprietary system which was considered as limited in its offerings of tools, configurability and cost. Linux on the other hand was deemed by the school IT Committee to be more secure and immensely configurable. This was due to its interoperability, developing features and numerous add-ons and tools that can be accessed on the Internet to provide whatever facility is needed. The IT Committee also felt implementing scalable operating systems at no cost within Linux were a congruent feature compatible with changes, community growth and adaptability of MOODLE at NDSHS. At the time of writing, 2009, the MOODLE server is running under a CentOS 5.3 using the classic Linux combination of Linux, Apache, MySQL and PHP (LAMP) for web serving and other related tasks. The CentOS system was chosen by the school technician as the preferred Linux OS because it is based on Red Hat which is an open source operating system. This package is free and has a vast array of server management tools available for free download and installation. CentOS also has the benefit of long term support for security updates and bug fixes. Furthermore MOODLE is written as an

Open Source product for LAMP configured servers and thus the MOODLE/CentOS is a natural choice.

Therefore Linux was chosen by the IT Committee as the preferred OS. The Committee identified data indicating Linux operates over 70% of the Internet and is free of licence fees. The LAMP (Linux, Apache, MYSQL, PHP) combination for serving web pages is identical to the requirements to run MOODLE which is cross platform but written with Linux in mind.

#### **2.5.3.4 Connectivity**

MOODLE is available from within the NDSHS site operating as the school's intranet and externally for users from home. Access to the internal network affords users high speed connectivity as users do not need to access the Internet for resources. This allows almost instant access to resources and displays items rapidly. However access for users from outside of the schools system presents a similar problem as access from any web-based application. Download speeds are limited to the speed of the connection of the user. This is also true of the upload speed limits. The connection, to MOODLE, must have the same speed in both directions to give the best experience for both uploads and downloads when accessing MOODLE from an offsite connection. Prior to July 2008, NDSHS fastest speed was limited by our local service providers and that was 512kb in both directions. A 4 GB both ways connection was established in July 2008 and has been installed to enhance service for NDSHS external school users.

#### **2.5.3.5 Speed of access to MOODLE**

Speed in accessing features contained in MOODLE and user satisfaction is a feature deemed desirable by the ICT Committee. The Committee recommended that the school technician attempt to maximise speed both for the internal student network and the teachers' administration network. To provide the best possible speed for teachers and students, the MOODLE server was configured by the technician to operate in parallel with the internal network. This was achieved by having an unbridged connection to the MOODLE server from the network. Unbridged connectivity terminates at the server and does not allow a further unprotected connection to the Internet via the MOODLE server connection. As such the internal school network and the internal MOODLE network connections are on two separate address ranges, one LAN and one WAN connection. By having the two access points, externally via SDSL and internally via out school network, NDSHS can provide a highly usable service giving high speed at school during normal school hours and a service to home comparable to speed from other services.

### **2.5.3.6 System administration and operational security**

EQ provides guidelines for the security of student data being available on the Internet (Education Queensland, 2007b). MOODLE contains only student names and student email addresses.

Security of this information is essential so that casual school visitors cannot gain access to other than the front page of MOODLE at the school site. To overcome this potential security risk, connectivity to the school's server through Active Directory was desirable. Active Directory system means that only teachers and students who have an active account at school can log onto the MOODLE server at the school.

As the responsible officer, the Principal required that Security and data maintenance, be in accordance with EQ policy (Education Queensland, 2007b). The measures outlined below were employed by the school technician to maintain the security and data maintenance as required by EQ.

#### *Operational Security*

CentOS Linux as an OS is very stable with long term support for security updates and bug fixes thus allowing it to be used for the life of the machine. Security is a major concern and a mandated requirement by EQ as detailed above, and so this server has been configured as a DMZ deployment. This is a necessary step as the MOODLE server is not designed to be a part of the school's internal network. Doing so is against EQ policy (Education Queensland, 2007b, 2009a) and may pose a security threat to the EQ corporate network. The server has one LAN and one WAN connection which are on different address ranges which are unbridged as explained previously. One address range is the main internal network 10.xxx.xxx.xxx range while the WAN connection uses the 192.168.xxx.xxx range connected directly to the Internet modem/router combination.

For added security 3 ports are opened on the external router which is: port 80 for web serving, port 25 for outgoing mail (incoming mail is not configured) and a secret port for external server management. Security was further enhanced by the rejection of all direct connections to the server from any network other than that possessed by the system administrator (school technician) of the MOODLE server.

This means that a direct connection to the server is not possible from any other network even if the two necessary passwords have been discovered by the attacker. The WAN router has been configured to not respond to “sniffing” attempts to discover what services are operating. The connection to the web or mail server are, for the purpose of this description, not classed as direct connections as information is server via daemons to specialised client software. A daemon is “a computer program that runs in the background, rather than under the direct control of a user; they are usually initiated as background processes” (MOODLE, 2008).

The inbuilt firewall in CentOS (and any other Linux) is highly configurable and can easily set up to allow one way initiation of web requests from the internal network. This means that web requests are serviced from the internal network to the MOODLE server but similar or any other requests such as pinging or remote access cannot be initiated from the MOODLE server to the internal network. This further enhances security. Normal external web requests to the school MOODLE server such as accessing web sites are accommodated by the WAN link. This dual network configuration ensures high speed responses when the site is accessed during school time via the internal network and normal simultaneous access to external users via the WAN connection.

Linux also has an extensive reporting facility. Each day the system can automatically log and collates security logs are these can then emailed automatically by the server to the system administrator to examine.

## **2.6 Description of the MOODLE site in action**

### **2.6.1 Introduction**

The MOODLE site has enabled a number of differing uses by teachers, students and administrators and other users since its introduction in 2005. The site has a number of features available for these three user groups. These include the ability for a user group to have differing access levels and control of functionality within courses. MOODLE during the research period was frequently updated and these upgrades modified functions contained within the MOODLE. These upgrades and the changes to features available are documented in the presentation of chapter 4 and chapter 5. Whilst this has improved functionality for users, MOODLE has maintained its original layout and navigation. The remainder of this section provides detail of the site itself as it operates at NDSHS.

## 2.6.2 The MOODLE homepage

The MOODLE homepage (see Figure 2.5) allows anyone to view some options before login. Users are presented with a layout that offers a range of options. All links on this page appear in blue and directs users to the login page. From this homepage features available include access to courses, links to related websites, upcoming events, statistical features or administrative functions. Access to specific features like course content is determined through permissions (enable differing level of site control) set by administrators. Access to the homepage is via a secure password is this the login, and this password follows guidelines required by EQ that all passwords generated have at least five letter characters, a number and an alternate character. Access for all users presents from a common homepage however once logged in the different groups are presented with different page options according to their allocated permissions.

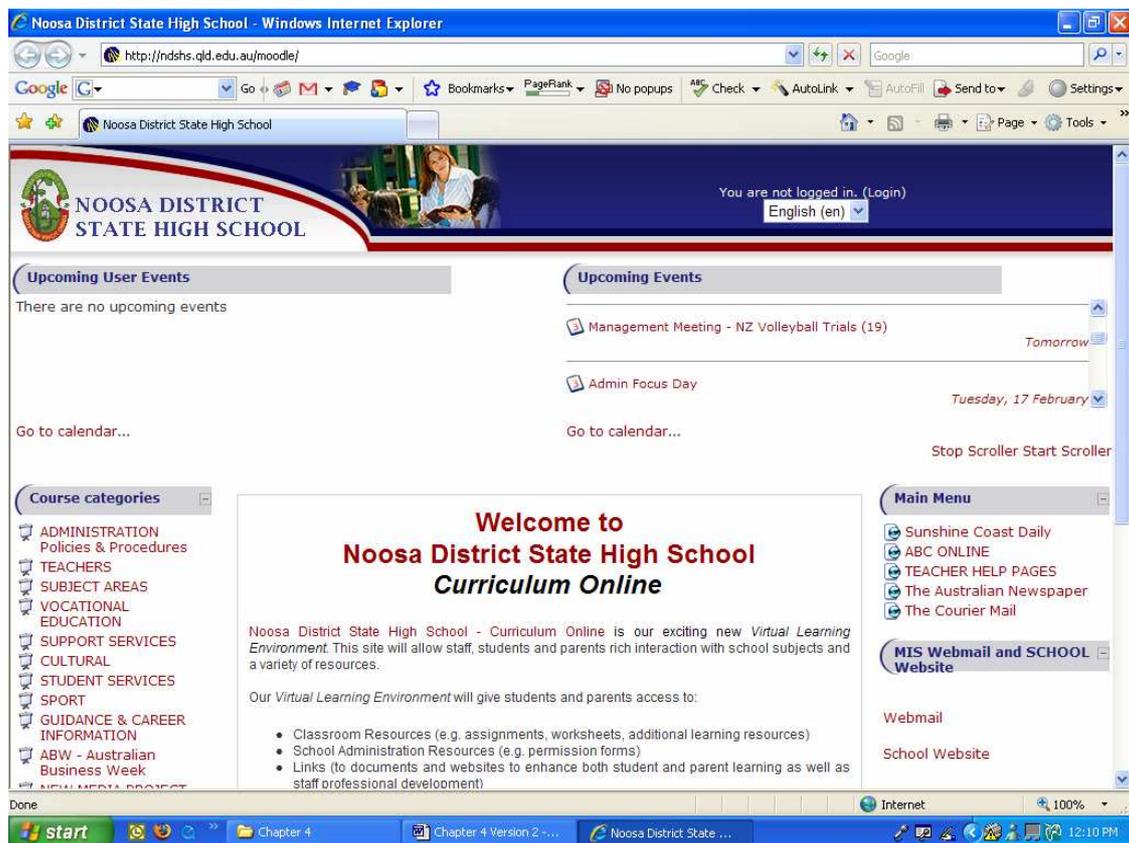


Figure 2.6 MOODLE homepage

The accessibility to MOODLE features for different user groups are explained in the following sections.

### *Student access to MOODLE*

Students are presented only with the courses to which they have been assigned. This feature aids student users in navigating to their courses. Once authenticated and assigned courses, students who subsequently login have only their courses appear in the course category section. Student ability to enrol in courses is controlled by course enrolment keys. This option prevents excess enrolments within a teacher's course. This is helpful feature for teachers as the users list develops from the course enrolments and helps to populate features within courses like the electronic grade books.

### *Teacher access to MOODLE*

Teachers are presented with their courses to which they have been assigned. Once authenticated and assigned courses teachers' login, they have only their courses appear in the course category section. Teachers have access to statistical options that allow them to monitor course access by students and usage by students within the site. These statistical features include the ability to monitor the usage of core features within courses allowing the tracking of usage by students. Further teachers can use quiz statistics to identify areas of course material they may wish to re-teach based upon the performance of their class. Teachers also have access to an editing function within their courses to enable them to add or remove resources.

### *MOODLE administrators' access*

On the front page of MOODLE administrators of the site are presented with a set of administration tools. Administrators have the ability to tailor the site by enabling or preventing functions within the LMS. They are also able to alter the text, themes and options a user sees on the front page. This ability also allows for course functions to be altered changing the structure of features accessible in courses across the site.

## **2.7 Conclusion**

This chapter has described the decisions taken by staff at NDSHS for the implementation in the introduction and continued use of MOODLE. Also presented are the features considered within MOODLE and the classroom practices that have drawn on the literature regarding aspects that promote sustainability. These have underpinned the strategies developed for professional development and the staged approach to implementation.

The next chapter presents the literature underpinning this case study and provides a justification to explore notions of sustainability as a key component underpinning this research.

# Chapter 3 – Literature Review

## 3.1 Introduction

The literature review concerns research associated with the factors that may influence the implementation, efficacy and sustainability of a site-based Learning Management System. Specifically the literature is examined to establish gaps that exist within current research and practices relating to the conditions that help establish sustainable school-based LMS sites. Sustainability literature is a core component within this discussion with the focus on the sustainable use of ICT initiatives within the practice and approaches used within a school site for the benefit of the classroom. Such information was useful to identify possible approaches for implementation of an LMS within a school and importantly support strategies to build staff capability, and the capacity for using LMS applications within their classes.

A preliminary examination of the literature on sustainable LMS sites established that there is an abundance of documentation. These are however general studies highlighting common themes drawn together through examination of more than one site using an LMS (OECD, 2007; BECTA, 2008; 2009). These studies are referred to in this chapter due to the lack of specific literature concerning the use of LMS within the school context. Accordingly, the literature search was narrowed to specific aspects concerning elements that help make an LMS sustainable. Pertinent themes identified from the literature for this research were identified from published papers concerning:

- Sustainability – the factors contributing to the development of systems within a school site supporting the use of an LMS.
- Communities – a group of people sharing a common interest.
- Connected communities – communities connected to each other in nature and emerge through practice.
- Learning communities – a group of people who share a common purpose and who collaborate with a view to developing new knowledge.
- Learning Management Systems–software applications used to administer, track, and report upon training programs, classroom and online events, e-learning programs, and training content.

The search of literature covered a range of professional fields and included business and governmental agencies. As well, literature concerning sustainability came from a variety of publications which were accessed through databases and Internet searches. The search period extended from 1987 through to 2009, helping to capture the literature documenting the development of LMS and the early documented cases of using these ICT applications.

## **3.2 Sustainable use of ICTs in schools**

### **3.2.1 Introduction**

The literature concerning sustainability is often used to describe a range of situations within a number of contexts. For instance sustainability has been described by the World Commission on the Environment and Development as the "...development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. 2). This definition offers broad markers for research but little in helping describe the actions of participants and the actions needed to sustain practices that may be needed within a site-based LMS. Sustainability as it applies to this research is concerned with the identification of the factors that contribute to the development of systems needed to use an LMS and the support needed by the users of the LMS to sustain its use now and into the future. These aspects are important within the context of this research helping with "exploring the sustainability issues which cross-cut between on-line community networking and the physical presence and organization of community networks" (Ripamonti, de Cindio & Benassi, 2005, p. 3.). In this research "Sustainability is the ability of an educational ecosystem to maintain scholastic processes, functions, diversity and productivity into the future" (Vota, 2009, p. 1).

### **3.2.2 Defining sustainability in a school context**

Broad literature searches concerning sustainability (BECTA, 2008, 2009; OECD, 2007) indicates that practices that help promote *in school* use of ICT may help toward the development of sustainable practices. Recent studies (BECTA, 2008; 2009) suggest that within the school context identifying and developing supportive practices that promote the use of ICTs, aid the implementation of technology within the school.

Local management of schools points towards the leadership team and key teachers as the personnel best placed to make decisions on how ICTs should be incorporated within the school (BECTA, 2008). Recent reports (Education Queensland, 2008b; Department of Education, 2008)

suggest ICT use that enables and improves the procedures in the classroom should help to develop the overall capacity of that site.

Literature concerning sustainability (Gurstein, 2003; Ripamonti, de Cindio & Benassi, 2005; Hennessy & Deane, 2004; Merkel, Clitherow, Xiao, L. Farooq, Gano, Carroll & Rosson, 2005) provides help in interpreting and describing sustainable practices that may maintain or improve outcomes for ICT use within a school community. This is summed up by Clark and Dickson (2003) who state:

The transcendent challenge is to help promote the relatively “local” (place- or enterprise-based) dialogues from which meaningful priorities can emerge, and to put in place the local support systems that will allow those priorities to be implemented.

Where such systems exist, the production of usable, place-based knowledge for promoting sustainability has been impressive indeed. (p. 1)

In this report Clark and Dickson (2003) also note the importance of identifying local priorities and localised support systems as two central themes in their research on ICT practice. The first theme identified is the development of local priorities for ICT use and secondly is the localised support systems needed to maintain ICT use.

To elaborate, the first theme states that central to the development of sustainable practice is the notion of a community. Merkel et al. (2005) stress this point: “Promoting sustainability involves finding ways of encouraging technology learning and planning in community groups.” (p. 1). Typically an ICT community present within a school can be found to represent a number of differing yet inter-related aspects that concern the people present, including the technical infrastructure and the organization of the networks within the school that support both staff and students. Other aspects of community include the interactions between students and their teachers within the site, the LMS MOODLE and the networks that are created that help support individuals working together.

Sustainability in the context of this dissertation involves finding ways to support groups as they learn about technology, as they identify ways that technology can be used to address organizational and community level problems, and as they develop plans to take on projects involving technology (Merkel et al., 2005). It is the combination of these factors, either formally or informally, that is explored through this research in its description and analysis of the ICT community at NDSHS.

The second theme explores how sustainability needs to include goals that are focussed upon the actions of its participants. In this theme, participants need to:

- find a way to sustain the production and sharing of resources;
- find a way to sustain the use and reuse of their resources they develop;
- engage in wider networks outside their scope developing links to help sustain development (OECD, 2007, p. 89).

Within the context of this research community-based ICT practices that support the development of capacity at the local level are examined through the Research Questions developed using literature concerning sustainability as outlined in chapter 1. In this context sustainable localised practices then must develop as a component within, and be supportive of, systemic ICT functions and goals. The ability to incorporate localised networks and the practices of users at this school site are examined in the following sections.

### **3.2.3 On-line community networking**

The following section examines online community networking for its relevance to the development of networks within schools. A key concept within community networks is the relationship between people and how community networks can promote participation. It is the participation of the members within this community that can drive changes across site.

As discussed above, the notion of community is implicit in the realisation of sustainable practice. In the literature, sustainable practice has been identified as helping to frame the interactions of members of the community (Ripamonti et al., 2005; Hennessy & Deaney, 2004; Merkel et al., 2005). Crucial in this development of sustainable practice and the connected community is the concept of networks. Networks as identified by Merkel et al. (2005) have a number of interrelated measures both *direct* and *indirect*:

Direct – these measures affect online communities and may be beneficial in devising new ways of solving specific problems (macro-area: *learning*), in lowering turn-over rates (macro-area: *identity*), in cutting time to market (macro-area: *innovation*) or in lowering coordination costs. Within this research this applies to the incorporation of ICT to the classroom and the impact upon EQ systems that drive administrative practice.

Indirect – these measures influence online communities but have side-effects that meet other goals: for instance ..... an online community of practice for its technicians aimed at sharing knowledge *and solving* problems in the real world? (p. 7).

The direct measures described by Merkel et al. (2005) apply to some of the initiatives currently operating within the EQ corporate ICT system. For instance Education Queensland's vision for ICTs implementation statewide is derived from the "Information and Knowledge Strategic Plan" (EQ, 2007c). The OneSchool initiative provides a common corporate architecture for all schools within EQ the key drivers within this initiative are OneSchool (EQ, 2009a), MOE (EQ, 2005) and MOSS (EQ, 2007a). OneSchool (2009a) interlinks with MOE and MOSS helping develop a complementary ICT framework that forms the backbone of the education department's corporate ICT network. This network is web-based and operates centrally from Brisbane.

Indirect aspects can also be identified within EQ's corporate architecture. For instance the provision of a centralised approach creates reliance upon the Internet. This can be problematic (BECTA, 2008) within individual school sites as they are limited by Internet service providers for speed in download and upload of resources. Within schools, people are vital in supporting the maintenance and use of the technical network. Users need a means to engage meaningfully using technology as part of their learning; therefore an indirect aspect is the engagement of both students and teachers with the more complex issues surrounding connectivity and networking. Networks as described by Hennessy and Deaney (2004) are dynamic in nature and within the school the discussions on their development and support need to be located in the school community. Action by users will focus on the changes or improvements they want to achieve. Doing so supports ICT development across the school and in turn may inform further applications for a school site.

Another aspect of online community networking is the notion of a *functional* network that allows for an exchange of ideas and helps drive innovation (BECTA, 2007; Müller-J., Juana M., Sancho, G., Hernández, F., Giró-X., & Bosco, A, 2006). Recent reports (EQ, 2008; BECTA, 2008; OECD, 2007) argue that the Internet is increasing the development of networks thus helping reduce the barriers of distance. Coupled with this emerging networked society is a requirement of a new and reflective skill-set in order that individuals are able to operate within such a system at a local level. This also impacts on the trend towards collaborative learning as it highlights the potential clash with a more personalised approach focussing on the individual. The literature

suggests that teachers within schools (EQ, 2008) need to be able to plan for these changes towards collaborative and networked communication within the school, and consider the implications upon their practices using ICTs within the classroom. It is here where the gap in the literature occurs. In reviewing the literature it was found there is a lack of documentary evidence of successful site-based implementation of sustainable ICT practice as it applies within a school site.

### **3.3 School communities**

#### **3.3.1 Introduction**

School communities and the aspects important in developing successful practice require an understanding of how individuals work together as a community. Beale (2000) defines a community “as a group of people sharing a common interest” (p. 14) Communities can also be described as people who share the same physical location. More recently with reliance increasing upon the Internet and improvements in technology, a community is being described as being distributed geographically and communicating using ICT (Merkel et al., 2005). Over a decade ago Rheingold introduced the concept of the virtual community, and this has furthered the debate associated with defining a community. Some researchers suggest a more individualized application of community, implying that individuals each have their own personal (or individualized) community (Wellman, 1999, 2001).

Castells (1998, 2001) suggests that the transition to an individualized community can be seen in the way people manage their social networks using ICT. Communities contained within this virtual space seem to operate from a need for action, based around common interests or a common purpose. In this respect, Rheingold (2002) in *Smart Mobs* considers social networking possibilities as the technology becomes increasingly more mobile and ubiquitous. A number of researchers (Wellman, 1999; 2001; Castells, 1998, 2001; Rheingold, 2002) consider the use of ICTs and have explored how technology will merge with our existing social contexts in the coming years. It is within this context of merging technology into the existing social context of the school, that this research examines a school’s response to these technological changes and how this school has incorporated technologies within the classroom context.

In this respect studies by Hennessy and Deaney (2007) and Hargreaves (2003) agree that there needs to be a focus on the actions of the participants and what underpins the decisions to use technology within the school context. These actions are essential in developing an ICT-based

community within a school setting. Hargreaves (2003) urges the need for careful planning in a move toward the incorporation of technology and notes: “It should be to create systems that challenge and motivate a critical mass of participants, and provide the capacity to reinvent the structures and practices from within” (p. 15). In this context the notion of a community is used to describe and develop localised practices that encourage individuals to work together.

In Queensland, the EQ policy (2008c) clearly articulates the technological framework, the desired user-skills and describes an emphasis upon the Internet as a mobilising force for information and society. However this EQ document does not provide strategies that can be used to promote ICT use between student and teacher. Also not addressed are ways of locating the use of ICTs within the current skill set of today’s teachers. The retrieval and interpretive skills required (BECTA, 2009) to make meaningful use of the ICT does not appear to locate usage within existing classroom practice.

Hargreaves (2003) stresses the importance of this aspect as he highlights the need for the governing bodies responsible for schools to consider how technology is delivered to the school sites. He notes the importance of having:

- a new *network infrastructure* of local and regional intermediary organisations, often incorporating Local Education Authorities and Local Learning and Skills Councils, dedicated to improving system capacity and accountable for improving the quality and pace of system learning
- rich, extended models for school organisations to use networks and highly varied forms of learning to engage directly with wider communities and jointly produce the wider conditions under which successful educational attainment and learning take place (Hargreaves, 2003, p. 14).

In achieving these ends, EQ (2007) suggest the importance of developing technical systems that allow for the development of a community. However it is here where the EQ connected community solution does not extend to incorporate the participation and input contained within the learning community model.

Numerous community-based ICT reports from, for example, the OECD (2007) identify the need to have a *community* as a core goal for projects. However there has been limited research into how individuals and communities can actually benefit from these initiatives. What is consistent within literature concerning ICT facilitation is the importance of the users and their interactions

that help to exhibit aspects of a community (Sévigny & Prévost, 2005). It is evident from the literature that if a community is to be a focus for achieving sustainable use of ICT that it need have certain qualities and attributes. Sévigny and Prévost (2006) articulate the differing means used in describing the nature of an ICT community. Communities, as they apply within the ICT context, can be described as either a *Connected Community* or a *Learning Community*. Table 2.1 summarises these differences.

Table 3.1  
*Connected Community vs. Learning Community*

Connected Community	Learning Community
Instrumental approach	Developmental approach
ICT access (computer and Internet access)	Community development strategy (cohesive action )
Development of citizen use capabilities	Development of citizen capabilities (participation)
Information dissemination and community promotion	Redefinition of local governance
Delivery of online services (municipal and others)	Networking of players player (communities of interest or practice pressure groups)

(Sévigny & Prévost, 2005, p. 3.)

The key characteristics of both approaches point to a difference in the manner in which each develops. Both a connected and a learning community have the overarching theme of developing ICT practice within educational sites, as is further considered in the following sections.

Work by Ballantyne (2003) describes how localised initiatives help build confidence and change habits of individuals using ICT. Central to this development is *ownership*. He notes that

Ownership can be defined as processes where local stakeholders take control and responsibility for the design, implementation, and monitoring of an activity. This “sense of ownership” is especially crucial to the sustainability of development activities. A development initiative will not be sustained without local “owners” who continue to be responsible for it after external assistance ends. (Ballantyne, 2003, p. 3)

Central to developing the idea of *ownership* within participants is the notion of *governance* (Ballantyne, 2003). Governance within this research context applies as it represents the development of the interaction between community members working together in developing the online learning environment.

### **3.3.2 Connected Community**

Sévigny and Prévost (2005, p. 3) indicate that a connected community reveals a number of attributes that help underpin the concepts used in describing a systemic approach. As such, a Connected Community is instrumental in nature and emerges through practice. This approach stems from a central location and provides a broad approach to the establishment of ICT and the skills of teachers within the schools' sites. The connected approach does not realise the importance of the localised decisions (BECTA, 2008) and the flexibility of adapting for projects at this level. There may be a potential for not establishing projects at the local level, as there may be too much "red tape" to gain a decision supporting local initiatives. Furthermore, policy formulated to support central initiatives may not be flexible in developing local approaches.

A synthesis of the literature from within EQ (2006c, 2007a, 2008b) and an examination of current studies (BECTA, 2008; OECD, 2007, 2008) reveals the current EQ corporate ICT structure reflects the adoption of a Connected Community framework. This is true of EQ's ICT approach and strategy for delivery, with the centre for ICT located in Brisbane with outlying sites (schools) serviced via the web (Education Queensland, 2007). This approach could be deemed a connected approach as it is institutional in nature and reflects the attributes described in the forgoing discussion.

### **3.3.3 Learning Community**

In contrast Kilpatrick, Barrett and Jones (2003), describe a Learning Community as a group of people who share a common purpose and who collaborate with a view to developing new knowledge. Longworth (1999) established that a Learning Community consists of a "group of people whose common goal is to create a vibrant, participative and affirming learning environment, through the active promotion of learning opportunities that enhance the potential of all of its members" (p. 17). The role of members within this community is to create new knowledge and understanding in an environment where collaboration rather than competition is encouraged (Angelo, 2000). In the context of schooling crucially, the role of the facilitator or teacher is to act as a coach and role model for learners and to help design an effective learning environment (Angelo, 2000). Supporting these assertions of a learning community (Sévigny & Prévost, 2005) have also described a learning community as

a territorial entity in which the population--individuals as well as public/non-public organizations--is mobilized to foster a state of permanent alertness. Members of the

general public undertake discussions, through ICTs and other means, then try the most productive approaches to development, which as a consequence contributes to collective knowledge. (p. 3.)

The literature (Kilpatrick, Barrett & Jones, 2003; BECTA, 2008) indicates that a learning community and the development that occurs within it centre on three central aspects:

- A site-based approach that can *grow* or be flexible.
- Developing a culture that develops and maintains networks.
- The capacity of the facilitators and mentors.

This approach accounts for and incorporates local solutions for the development of ICT within the school site. In their research on Learning Communities, Kilpatrick, Barrett and Jones (2003) indicate that the underlying principle is that one person alone does not have sufficient knowledge and skills to respond to the complexities of our institutions and our societies. Using a Learning Community paradigm requires developing internal school-based approaches that rely upon individuals and their skills in using ICT (Kilpatrick et al., 2003). In this dissertation the approach developed incorporates localised initiatives.

A study by Müller et al. (2006) identifies the importance of developing in school strategies that go beyond the placing of computers in classrooms. These authors argue that ICT development must aim at capturing the varied long-term requirements necessary for educational change in conjunction with ICT. Key aspects for lasting contributions are identified, among which “network building and applying a ‘bottom-up strategy’ for changes” are given particular importance (Müller et al., 2006, p. 1).

EQ recognises this importance within their policy documentation *21 steps to 21st Century 1-to-1 success* (Education Queensland, 2008c) detailing the importance of the discussions of a localised vision for implementing a 1:1 approach. Again the EQ policies support localised decision making under this model but, at present, their ICT policy (Education Queensland, 2008c) maintains decisions upon architecture as a centralised function. This approach affords schools little choice in implementing a localised ICT solution. This seems to counter strategies that may be developed locally that could enhance support in making decisions about localized school ICT practice.

### 3.3.4 Physical presence

This research concerns the physical actions that occur within the site that helps to establish networks, in turn creating sustainability. Merkel et al. (2005) and Tanner (2004) identify strategies that specifically target and engage users. According to Merkel et al., (2005) the technical and conceptual tools associated with ICT need to be presented and associated strategies developed in ways that promote long-term learning and uses. These authors further state, “We want to avoid creating a situation in which community members are dependent on a technical tool that we create” (Merkel et al., 2005, p. 4). It is here that an open source LMS was selected as it can be modified which helps to develop *input* from users.

Tanner (2004) suggests strategies that are employed within the site need to allow time for exploration and offer challenges beyond learning a specific technical function. In addition, Tanner (2004) articulates the need to consider the human element needed to help construct and identify meaning or use for the technology. In this respect, Hennessy and Deaney (2007) and Sévigny and Prévost (2005) identify the need for the interaction of members within the site. They argue that success in the incorporation of ICT can occur by using methods for training that allow interaction and reflection upon the technology used. For instance in their research, Merkel et al., (2005) reported:

One value of the training sessions was that it provided the community groups with a dedicated stretch of time where they could think about the material that they would like to see online and the overall structure of their web site. (p. 7)

Research into ICT communities by BECTA (2006) and the OECD (2007) has identified similar traits needed for sites moving toward sustainability. Situating the LMS within the school site helps develop curiosity, internal networks and risk-taking from participants. According to Hearn, Lennie, Simpson and Kimber (2005) these site-based actions can improve the overall skill set of the community they represent. These authors found that

....local needs and interests must be addressed and the community’s sustainability goals must be clear. It can be extrapolated that success in attaining these goals necessitates the community having effective opportunities to be involved in deciding on the project(s) to be pursued and in evaluating it. Therefore, it is essential the community “owns” the initiative (Hearn et al., 2005, p. 8.)

The foregoing suggests that ownership within a school site can help engender a sense of pride within the community and helps develop the essential latch for teachers and students working on resources for classrooms.

Furthermore, within school sites consideration of how to describe ICTs within the context of overall operation of a school needs consideration. Siemens (2005) presents an alternate description concerning the operational processes within a school. He puts forward the notion of *connectivism* which he describes as:

the integration of principles explored by chaos, network, and complexity and self-organization theories. Learning is a process that occurs within nebulous environments of shifting core elements – not entirely under the control of the individual. . . .  
Connectivism is driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognize when new information alters the landscape based on decisions made yesterday is also critical. (Siemens, 2005, p. 3)

Connectivism seeks to locate practice which has an impact upon the wider educational landscape. The recognition of individuals and their role within developing an organisation is outlined as an integral component in the development within an organisation. Siemens explains further:

the starting point of connectivism is the individual. Personal knowledge is comprised of a network, which feeds into organizations and institutions, which in turn feeds back into the network, and then continue to provide learning to individual. This cycle of knowledge development (personal to network to organization) allows learners to remain current in their field through the connections they have formed. (Siemens, 2005, p. 4)

The notion of connectivism, drawn from the work of Siemens, is used by Carr and O'Neill (2006) to describe the interactions between users of ICT. They explain that “connected learning environments are powerful and multi-dimensional offering broad opportunities for self directed learning, experimentation and development of deep and enduring understandings of complex processes” (Carr & O'Neill, 2006, p. 2). They also articulate the need for the consideration of the individual learner and the response by education to cater for the needs of this learner. They note that digital solutions that enhance skills and capabilities for today's learner need to be timely, reflecting skills in current use in mainstream environments but afford a level of security that keeps the student safe from unsavoury elements in wider society.

The forgoing literature indicates that schools need to address two issues. Firstly, educational systems need to focus on the digital age skills used by today's learner. Secondly, school systems need to adapt and change to reflect this skill through the provision of a secure ICT environment. In this research setting the school has incorporated and utilised a site based LMS that incorporates security measures providing users access to resources and networking tools to promote the development of an online community.

Communities (Education Queensland, 2008b, 2009a) are at the forefront of current EQ initiatives, particularly in the areas of "e-learning for schools and e-learning communities at schools" (Education Queensland, 2008a, p. 4). Both these areas identify ICT as an integral component in delivering and engaging schools within their wider communities.

### **3.3.5 Sustainable consumption**

As this research concerns sustainable use of an LMS, it is appropriate to consider the notion of sustainable consumption. It is claimed in the literature that sustainable consumption is an integral consideration in sustainable development (OECD, 2008; Lamb & Kling, 2003). In this respect;

Sustainable consumption gives consumers the opportunity to consume products and services that meet their needs in an efficient and effective way, while minimizing the negative environmental, social and economic impact. The ultimate goal of sustainable consumption is to improve quality of life for all consumers in our and future generations, while minimising associated environmental impacts. (UNEP, 2005, p.3.)

Sustainability research has focussed upon identifying workable solutions to social and environmental imbalances through more focussed actions from participants. Sustainability literature (Gurstein, 2003, Merkel et al, 2005) identifies an aspect common with sustainable consumption through the articulation of the importance placed upon the "local" dialogues (Clark & Dickson, 2003) helping develop solutions benefiting localised need.

The Department of Education Tasmania (2008) suggests that to address sustainable consumption using ICT solutions, schools need to consider 4 areas:

- Operating ICTs – student learn about the differing means of storing, filing and retrieving data. Students also focus on compare different devices, selecting the most appropriate for the tasks they are completing.

- Communicating with ICT – students become involved in planning for online sustainability projects. Students consider what social networking tools will they safely or sustainably use and for what purpose, and how they will contribute to developing sustainability knowledge
- Inquiring with ICT – students need to be able to do to conduct effective searches. Students also need to develop social networking spaces to enhance their knowledge of sustainability.
- Creating with ICTs – teachers need to consider online resources and the software packages used to assist students to create ICT products.

(Department of Education Tasmania, 2008)

### **3.3.6 Organization of community networks**

The increasing development of Internet-based tools and their incorporation within organisations necessitates consideration of how organisations best use web-based tools within their practice. Recent reports (Education Queensland, 2008, BECTA, 2007, 2008; OECD, 2007) argue that the Internet is increasing the development of networks to help reduce the barriers of distance, access to expert knowledge and the isolation experienced by some communities. Identified within this research are some of the barriers which include access to expert people due to geographical isolation or using ICT to meet *virtually* with others. Coupled within this emerging networked society is a requirement of a new skill-set helping individuals understand and use ICT responsibly, in order that individuals are able to operate within such a system. The trend towards collaborative learning highlights the potential clash with a more personalised approach which focuses on the individual. According to Lamb and Kling (2003) teachers within schools need to be able to plan for these changes towards collaborative ICT learning spaces and consider the implications upon their planning and development practices using ICT within the classroom.

Within the sustainability literature (Ripamonti et al., 2005; Hennessy and Deaney, 2004; Merkel et al., 2005) a common theme emerges that concerns the importance of the interrelationship between community members. Communication and discussion between members of the community help to establish the networks that in turn develop a community. Interrelationships are strengthened through common practices and the regular contact between members of a community. A number of researchers (Tanner, 2004; Merkel et al., 2005; Hennessy and Deaney, 2004, 2007) have shown that community settings are able to use technology to address problems that they think are important. This decision making process established through collaborative

actions allows for site-based decision making, in turn helping develop the concept of ownership and therefore be more sustainable (Ballantyne, 2003).

### **3.4 Use of a LMS in schools**

#### **3.4.1 Introduction**

The following section concerns the use of an LMS within this school context and a discussion of the literature supporting LMS use.

#### **3.4.2 Describing an LMS**

The following definition helps to describe the features that an LMS contains.

LMS - A Learning Management System (or LMS) is a software package that enables the management and delivery of learning content and resources to students. Most LMS are web-based to facilitate *anytime, anywhere* access to learning content and administration. (Ellis, 2009, p. 1)

A common feature afforded through the operation of an LMS is that e-learning can be organized and facilitated as an integrated system. Different modules and plugins can be integrated with core functions within a single system which offers a range of tools to operate and manage an e-learning course. All digital learning activities and materials in a course are organized and managed by teachers and are presented within one coherent system. An LMS may offer differing features. These can include:

- discussion forums
- file sharing
- management of assignments
- lesson notes
- self-marking quizzes
- activities (including word and math games)
- varying resource types
- question types
- data field types (for the database activity)
- flexible themes
- authentication methods
- enrolment methods
- content filters (MOODLE, 2009).

One strength of an LMS is that it has a number of features that allow student interaction within a secure supported community. In this research, MOODLE has been customised for the applications within this school through the use of differing plugins that enable a number of functions that allow for individuals to customize their space. These features enable school staff to create customised courses with specific web pages that may include services such as news, weather or digital tutorials, RSS (Really Simple Syndication) feeds, all within a single page that updates automatically. Within this environment users can access various tools that enable them to have a degree of control (BECTA, 2007) over their own online content. Therefore an individual user can develop a personal portal which can provide a single point of aggregation for their digital content.

In fact, tools that encourage learners to bring in and link to their own existing online content (personal blogs, wiki's and content on social networking sites, for example) are more likely to engage them in online-supported learning in schools, colleges or universities than if we continue to insist on a rigid separation between institutional life and the outside world. (Ellis, 2009, p. 8)

LMS portals themselves are not a new concept within literature (MOODLE, 2007; BECTA, 2008). Modes of portal facilitation generally fall into two categories. The first category is portals that are operated externally from the school and can present localized content without the need for a high level local knowledge or engagement with the communities for which the portal represents. These sites are strictly hierarchical in deployment. Development decisions are confined centrally with limited bottom-up feedback being incorporated into the functionality of the site. The other category is a localized portal operated from within the site helping the development of a localized community. In this case, staff at the site make the decisions for tailoring the portal based upon the community need. Communication and sourcing solutions help develop ownership and governance (Ballantyne, 2003) and in turn challenge teachers to network with others.

### **3.4.3 Use of an LMS in schools**

In Queensland, studies undertaken by EQ (2005, 2007b) found mainstream use of ICTs is most likely to occur when the vast majority of teachers are able to perceive that the technology will assist them and their learners. In this respect Oliver (2005) found that for many teachers the use of ICTs may present more impediments than opportunities for learning. He suggested that one key strategy needed to achieve this integration of technology is;

”research activity that explores implementation and application issues” Too often in the past the moves to embrace educational technologies have been led by the technologies themselves. The need for research and inquiry to address issues of implementation and application at the coalface seem a logical approach (Oliver, 2005, p. 6).

Within the school context, using an LMS provides a way for “enterprises to provide a consistent look and feel with access control and procedures for multiple applications, which otherwise would have been different entities altogether” (BECTA, 2007, p, 4). Consistency in the format and pathways used within an LMS is an important aspect in the development of ownership, as users access a space where their own digital content is available and spaces are provided that allow for a certain amount of tailoring to suit their uses. Using an LMS within a school enables determinations about the classroom ICT design, the features used and the applications incorporated within this online classroom. Allowing for this level of input from classroom participants may support the conditions (trust, reciprocity and teamwork) outlined in describing a learning community. In this setting Sévigny & Prévost (2005) noted that involving teachers in developing collegial practice stimulates further discussion about ICTs.

It can be deduced from the literature that an effective learning platform that is embedded in the working practices of the school can offer a wide range of benefits to teachers, pupils, parents and at the same time support management and administration (EQ, 2007b, 2008a). Some of the characteristics that illustrate effective ICT practices supporting improvements in school efficiencies using an LMS enable teachers to:

- access a wide variety of learning materials that they can customise for the exact needs of their students
- put their resources online page by page, lesson plan by lesson plan, so colleagues can access them both in school and from home
- access lesson plans from colleagues to support supply cover
- assess, monitor and track individual and group progress
- receive submissions of work from students in one area that is easy to manage
- manage their timetables, diary, email and discussions within personal desktop space
- increase their ICT competence and confidence. (BECTA, 2008, p. 5)

Supporting this development an LMS needs to have the ability to evolve with the practices that develop within the school site. Adaptations, scalability and the activity within the site help inform

the direction and functionality the individual site pursues (Ballantyne, 2003). Central within this developmental framework is site governance. As stated previously, teachers and students work together in developing resources for courses and also can review modules and plugins available within the site. The actions of these participants help contribute to the development of a learning community as described by Sévigny & Prévost (2005).

### **3.4.4 Selection and implementation of an LMS at a school site**

#### **3.4.4.1 Introduction**

The literature (Ripamonti et al., 2005; Hennessy and Deaney, 2004; Merkel et al., 2005) suggests that incorporation of an LMS into a school environment need to be a considered decision incorporating factors such as technical support based at the site, costs associated with set up and maintenance and the risks and challenges associated with growing and sustaining a site. In this regard BECTA (2008) describes a number of approaches that enable schools to evaluate the effectiveness of implementing ICTs into a school setting. These approaches require that the site evaluates the impact and benefit of implementing an ICT solution. Research undertaken identified a limited range of specific evaluation models designed for schools. However two models that were deemed appropriate by the school ICT committee for this research into the selection and evaluation of a school-based approach for ICT were:

- FAVE model (BECTA, 2008)
- LMS evaluation tool designed by Alvarado (2004).

#### **3.4.4.2 Literature guiding the selection of evaluation instrument**

The selection of evaluation instruments was confined to searches relating to evaluations conducted within a school context, as it was not within the scope of the research to explore the efficacy of a range of possible evaluation instruments that could be used. In this respect BECTA (2008) recommends schools use a recently designed evaluation model that incorporates a number of principles drawn from analysis of successful site-based initiatives that have improved localised school ICT practice. This model by BECTA is referred to as the FAVE model. This acronym represents:

- F, fundamental – essential to achieving the educational vision and a fit-for-purpose environment
- AV, added value – benefits that the school would find desirable
- E for excellence – utilisation of outcomes that will contribute to achieving desirable educational outcomes.

The FAVE model is designed to stimulate debate about the technology factors that influence learning and teaching, and how these can impact on the design of educational environments. The FAVE model helps direct the development of planning a site based model for an existing community, but examines the impacts for site practice long term. The FAVE model selected is most suitable in this research context as it provided a scaffold that targeted developing key areas of ICT use and importantly locates development within teacher practice.

The second model proposed by Alvarado (2004, p. 2) focuses upon the technical functionality of an ICT application. This model was selected as it complemented the FAVE model having a similar, easily implemented set of criteria that helped to match features of the LMS reviewed against the desirable traits identified by staff using of the FAVE model (BECTA, 2008).

Alvarado's model identifies seven elements as critical in selecting an LMS. These are:

- skill assessment - : Skill assessment revolves around learners assessing their competency gaps, matching those gaps to a prescribed curriculum to address those gaps and developing a learning plan that is attainable and executable to close those gaps that were identified.
- content access -This area focuses on how learners access the content. This involves the medium (e.g., classroom, CD-ROM, online, etc.) in which the content is delivered, the method (e.g., instructor-led, self-paced, blended) in which the content is delivered, the languages in which the content is delivered and to whom the content is being delivered (e.g., employees, customers, partners, etc.). In addition, the access of the content from a learning content management system (LCMS) is also a component of this area
- enrolment and tracking - Enrolment and tracking considers entries in the course catalogue that learners can access, enrolment in event-driven classes and launching of online courses, collecting funds through an e-commerce process if applicable, tracking activities and completions, and generating reports on the information being tracked.
- learning evaluation - The learning and evaluation area involves the creation of survey instruments and test assessments to collect data associated with evaluating the effectiveness and efficiency of learning programs, as well as tools to analyze the data collected.

- marketing and communications - This area considers communications between learners and instructors, learners and administrators and even learners and learners to form learning communities
- content development - Content development encompasses authoring, maintaining and storing the learning content.
- cost (Alvarado, 2004, p. 2)

#### **3.4.4.3 The literature guiding the evaluation process**

Three LMS platforms, namely Sakai, MOODLE and Blackboard described in chapter 1 were evaluated using the two approaches to evaluation described above. The criteria outlined by Alvarado (2004) and BECTA (2008) both suggest that an evaluation of an LMS should examine the user features offered by each LMS and compare these with the functions identified by staff. Within this research context, teaching staff at NDSHS identified the ability to make choices in incorporating functions within the LMS as desirable.

*Choice* as a feature was noted by participants as important. Literature surrounding participants having choice drew from a study conducted by BECTA (2009). This study focussed on using an open source LMS and highlighted the ability to tailor and personalise an LMS as an aspect helping develop student input and engagement. Students input were considered using ideas from this research.

Teacher practice and their interactions helping to incorporate ICT were deemed an important consideration. Literature (Hennessy & Deaney, 2004; 2007) helped locate the discussion surrounding the identification of actions where teachers worked together and how this work came about. This was important in considering the support structures needed to develop and sustain ICT practice. Supporting this ability of users to source and trial applications for themselves is literature surrounding communities (Hennessy & Deaney, 2007; Merkel et al, 2005). Hennessy & Deaney (2007) note the importance of developing wider networks helping to stimulate and refresh ideas that surround the use of ICT. For this reason MOODLE was selected having a large well developed community that could be immediately accessed by users at this site.

Another feature considered as part of the selection was access to *parent* websites for the LMS where technical information and *test* sites can be accessed to trial features. Access and usage of these *parent sites* may help in the development of discussions by users concerning functionality

and in turn may help to develop ownership and governance, a critical feature of sustainability, as suggested by Ballantyne (2003)

### **3.5 Conclusion**

This chapter has examined the literature from a number of sources and the themes discussed used to inform this research. The themes identified were used to establish a framework from which to undertake the implementation of an LMS in the development of a localised ICT community. In addition the review of the literature has identified two gaps concerning the use of LMS in schools within Australia. Firstly, there appears to be no documented studies detailing the operation of a site-based LMS in schools within Australia. Secondly, the review of the literature identified there is an absence of literature that documents sustainable use of ICT in a school community using a LMS. In this respect, sustainability literature and specifically that on sustainable consumption have been used to evidence and locate community as an important aspect of sustainability in maintaining ICTs in a school setting.

Central within discussions related to community is the consideration of networks and how these develop. It was established in the foregoing review that networks are considered crucial in describing the interactions of ICT users within the school. Within this context the sustainable aspects of a community reside within the purpose and actions of its members. Furthermore, communities constantly evolve and redefine aspects of why a community exists and what it is being achieved within the site helps develop the site-based support and practices that concern ICT. These suggest that support and community practice would appear to help engender and grow networks both formal and informal (Merkel et al., 2005). These aspects have the capacity to influence actions over other individuals within the community.

The literature considered in this chapter describes a group of site-based ICT users as a *learning community* (Sévigny & Prevost, 2005) and this concept has been used to interpret the initial growth, the support networks that develop and the establishment of practice, that continue to underpin development within a site. Ballantyne (2003) helps to account for the uptake and continued growth of a site-based model linking ownership through outlining changes in teacher practice and confidence in using ICTs.

This literature concerning learning communities provides a framework for this school in seeking to maximise the potential of ICT usage by students, teachers, administrators and more widely the school community. This literature provides evidence for the need to develop a sustainable approach toward development of the ICT community. Further, the literature on communities suggests the benefits of community development within the localised context as being important to its survival. This in turn provides evidence toward developing flexibility and the capacity within the site-based roles and members within the localised community (Ripamonti et al., 2005; Hennessy and Deaney, 2004; Merkel et al., 2005).

The review of the literature has been used to explore the concepts associated with sustainability. The concepts identified by a number of researchers (Ripamonti et al., 2005; Gurstein, 2003; Hennessy and Deaney, 2004; Merkel et al., 2005) suggest that five broad *markers* are associated with achieving sustainable practice in a school context. These markers are

- Networks – development of user networks and the collaborative actions that occur within the LMS
- Adaptations – adaptations of practices that incorporate ICT of users involved in the use of this LMS
- Scalability – the ability of the LMS to incorporate functions desired by participants and have the capacity to grow
- Governance – the willingness of participants to undertake tasks or roles willingly supporting the development of the LMS
- Site activity – usage of the LMS both during school time and out of school hours.

These markers help identify and locate actions that can be used to underpin the development of a localised ICT platform. These actions have a number of common elements that can be drawn together to describe practices and processes within a school site. These markers will be used in chapters 5 and chapter 6 as a framework for presenting results and discussion related to this research.

# Chapter 4 – Research Methodology

## 4.1 Introduction

Previous chapters have provided details of the background and literature related to this research on the issues that may affect the implementation of a sustainable LMS within this high school setting. In this chapter, the research methodology chosen to evaluate the implementation and use of the LMS is presented. The chapter begins with an overview of the inter-relationship between a researcher's belief and a discussion of the paradigms considered for this research. The chapter then presents an explanation of the ontology and epistemology for the research and the assumptions in the study related to the chosen paradigm. The chapter proceeds to discuss the use of case study methodology used to address the research questions posed in chapter 1. This chapter then outlines data collection and analysis techniques that have been employed to explore the research questions. The chapter concludes with a summary of the research and ethical considerations.

## 4.2 Overview

Researchers acknowledge that while decisions about the research process are informed by the nature of the research there needs to be recognition of the effect of the researcher's personal world view on the research process and outcomes. The literature reveals that for this research, both the constructivist and interpretive paradigms could have been adopted as each lends themselves to this type of research (Yin, 2003). The selection of a paradigm for this research has involved consideration of the nature of the research and how it could be employed to facilitate it. Developing a research approach has incorporated the beliefs held by the researcher about how best to undertake this study. Maxwell (2005) argues that research design is affected by the set of ideas and beliefs held by the researcher. These beliefs may influence how the research may be conceived, undertaken and reported. It follows that a researcher's beliefs can influence the researcher's preferences towards views about the ontology, the relationship between the epistemology and to the selection of methods appropriate for the research. In articulating the basis of this research process, the researcher needed to make explicit the paradigm drawn upon and: "be knowledgeable about the philosophical issues embedded in research and their pragmatic implication" (Bettis & Gregson, 2001 p. 2).

A paradigm in this research context “represents a worldview that defines, for its holder, the nature of the ‘world’, the individual’s place in it and the range of possible relationships to that world and its parts” (Guba & Lincoln, 1996, p. 107). The environment for this research includes both the virtual and physical classroom settings. The implementation of MOODLE at NDSHS centered on incorporating LMS applications to enhance student and teacher practices. Students were encouraged to utilise MOODLE functions that helped develop self-directed learning through the provision of resources that allowed students to work independently. Teachers were asked to incorporate self-marking exams using electronic grade book to identify if marking loads and profile sheet completion could be improved through using electronic versions to save time. The aim of this research described in chapter 1, is to explore ICT practice through the introduction, implementation, use and effects of a LMS within a school site. An assumption is made that participants have made the choice to use a LMS and the focus of the research is on the nature and types of uses of the LMS. This view reflects the nature of the researcher’s belief in offering a *choice for users* emphasising flexible options for students, teachers and others using the LMS. This belief permeates the focus and design of this research.

### **4.3 Research paradigms**

An empiricist paradigm can provide the research with *objectivity* helping identify tangible results stemming from the methodology (Denzin & Lincoln, 2000). On the other hand a constructivist paradigm is concerned with understanding human behaviour from the actors own frame of reference (Guba & Lincoln, 1996) and as such can provide an insight of interactions of participants and their associated work.

Table 4.1 presents the paradigms considered for this research. It can be seen from this table that within each paradigm, the main ideas are summarised and its applicability to this research is presented. The empiricist paradigm identifies objectivity as a guiding principle, with the researcher required to stay neutral in relation to what is being researched. An empiricist paradigm considers facts and values as separable entities (Guba & Lincoln, 1996). While empiricist research maintains objectivity as a guiding principle, the approach also may be used to describe the causal relationships that may occur and attempts to develop generalised principles, which may be used to describe other phenomenon. Empiricist research can then seek to use these generalised principles in describing phenomena applied to other instances (Denzin & Lincoln, 2000; Olson, 1995). The idea behind this type of research is to study frequencies, averages, and other statistical calculations. The main goal of this type of research is to describe the data and characteristics

about what is being studied. The type of data obtained from this research can develop an understanding or make sense of the decisions made. The researcher deemed that use of an empiricist paradigm is limited, as the research concerned decisions made and the interactions between individuals that help maintain a LMS community.

Table 4.1  
*Paradigms*

Empiricist	Constructivist	This research
Ontology - naive realism, reality is objective. There is one true reality.	Ontology - the nature of the reality is relative, local, specific and co-constructed. What is known is transactional and subjective. There are multiply realities.	Researcher is inseparable from the study and the ontology is relative and specific to this school context.
Epistemology - an Empiricist believes that an observer is detached from what is being studied. The results are objective.	Epistemology - the observer and what is studied are related and have an effect on what is observed. It is not possible to separate the observer from what is observed. The results are a subjective interpretation of the observations.	The knowledge developed within this research context has developed due to collective actions of the research participants. Results will be both objective (data logs) and subjective (assigning meaning to data).
Methodology - the aim is to verify hypotheses using chiefly quantitative methods and experimental design.	Methodology - the aim is to explore the reality of what is happening as a LMS is introduced into a school community. This requires a cyclic iterative process of data collection, analysis and interpretation.	This research will use a case study design framework to explore the implementation of a LMS into a school community.

(Adapted from Guba & Lincoln, 2005)

Developing meaning and examining the underlying decisions made by participants is central to this research process. This will concern developing an understanding of the complex interplay between users of the LMS. It follows that the research is appropriately situated within a constructivist paradigm. This paradigm fits with the researcher's belief about how knowledge is constructed, as elaborated by Carroll and Swatman (2000).

All researchers interpret the world through some sort of conceptual lens formed by their beliefs, previous experiences, existing knowledge, and assumptions about the world and theories about knowledge and how it is accrued. The researcher's conceptual lens acts as a filter: the importance placed on the huge range of observations made in the field

(choosing to record or note some observations and not others, for example) is partly determined by this filter. (pp. 118-119)

The constructivist paradigm is interpretative and asserts that “it is impossible to separate the inquirer from the inquired into” (Guba & Lincoln, 1996, p. 163) because both researcher and researched participants are integral parts of the research process (Wiersma, 2000). The researcher and the research participants, within this paradigm, co-construct meaning through working together shaping the research as it is being undertaken. Knowledge is identified as socially constructed, with a key task of seeking meaning in context - the subject matter must be set in its social and historical context so the reader can see how the current situation emerged (Klein & Myers, 1999).

The above brief examination of the empiricist and constructivist paradigms has identified the strengths and shortcomings of each as they apply to this research. Selection of the constructivist paradigm for this research enables the researcher to develop understandings of *why and what* participants deemed important in making the decision to use the LMS. A key task in interpretive research is seeking meaning in context, like how the use of ICT may change a teacher’s pedagogical approach. The constructivist paradigm provides the researcher with a range of methods of data collection in locating meaning in the context of this case study of the school. This research is “aimed at producing an understanding of the context of the information system and the process whereby the information system influences and is influenced by its context” (Walsham, 1993. p. 23).

#### **4.3.1 Ontology and epistemology**

As alluded to above, the ontology informing this research has influenced the paradigm choice. For this research the underlying assumptions made about the issues being investigated, led to using a constructivist approach. Table 4.2 presents the assumptions for each paradigm.

Table 4.2

*Metatheoretical Assumptions about Empiricism and Constructivism*

Assumptions About	Empiricism	Constructivism	This research
Ontology	Person (researcher) and reality are separate.	Person (researcher) and reality are inseparable (life-world).	Researcher is inseparable from the study.
Epistemology	Objective reality exists beyond the human mind.	Knowledge of the world is intentionally constituted through a person's lived experience.	Knowledge develops within the school context collectively.
Research Object	Research object has inherent qualities that exist independently of the researcher.	Research object is interpreted in light of meaning structure of person's (researcher's) lived experience.	MOODLE is interpreted through the researcher's lived experience of being in the school and examining responses from participants.
Framework	Experimental	Case study	Case study
Theory of Truth	Correspondence theory of truth: one-to-one mapping between research statements and reality.	Truth as intentional fulfilment: interpretations of research object match lived experience of object.	Interpretation is based on data logs and focus group interviews, and researcher's own experience

(Adapted from Weber, 2004, p. 2)

As can be seen from Table 4.2 the research proceeds using a constructivist inquiry lens. Dealing with the research context as it applies to the research questions necessitated an examination of a variety of assumptions. One major assumption made in this research is that students and teachers can work together in developing approaches for the use of ICT.

### 4.3.2 Researcher's position

The position the researcher has taken in this research leads to the adoption of the interpretive approach. This approach will enable an exploration of the research question posed in chapter 1.

The researcher has the belief that in exploring the experience of users at this site, it is difficult to divorce users, including the researcher, from the decisions and behaviours that contextualise the school's operation. Results obtained during the course of the study can then be described as a

subjective interpretation of observations. This complexity is reflected in variables such as year level, school subject, home background, school policies, assessment deadlines and a range of other factors that may effect participant decisions. Thus the nature of this research situates this researcher within the world of experience where the elements of the interpretive paradigm (ontology, epistemology and methodology), reflect the study and the nature of the inquiry (Denzin & Lincoln, 2000; Giddens, 2003).

As stated above, the researcher has adopted an interpretivist belief system in that reality is subjective and that multiple realities are being considered. The researcher believes that the role of the researcher in conducting this research is to collect evidence and to interpret the data collected from the participants. During the research phases the researcher was a teacher at this site and as such was immersed within the research site with the other participants. This approach to research is consistent with the epistemology of interpretive inquiry with knowledge of the world being intentionally constituted through a person's lived experience (Weber, 2004).

#### **4.4 Choice of research method**

##### **4.4.1 Introduction**

A number of alternative research methods were considered as possible options for examining the research questions as presented in chapter 1. Grounded theory method (Markus, 1997) or anthropological approaches such as ethnography (Wiersma, 2000) were considered but rejected in developing the research approach. This research could be done as a field study but a case study approach was preferred over field study research as field study research is usually a research approach that is considered very time consuming (Myers, 1997). Similarly, a grounded theory method was not used as this study is not developing theoretical frameworks to explain the data as it is adopting a practical research approach (Markus, 1997).

Given the above context it was deemed that a case study method be chosen over other methods due to the nature of this research. A case study as used in this research is defined by Yin (2003) as an "investigation of a contemporary phenomenon within its real – life context", especially when "the boundaries between phenomenon and context are not clearly evident" (p. 13).

Chapter 3 identified five markers of sustainability for ICT practices and discussed a number of concepts that may influence school-based ICT practices. In summary, the literature states sustainable school-based ICT action that incorporates an LMS should be a combination of

individual action, community risk taking, and a community's action incorporating challenges and effort that result in participants within the community developing a shared resource. Describing these actions necessitates a research method that enables each of the Action Phases for the implementation to be examined as presented in Table 4.4. In this respect Yin (2003, p. 3) describes a case study method as having "three purposes – exploratory, descriptive or explanatory". A case study methodology is appropriate to use in this research as it involves a holistic approach providing documentation over a period of time of contextual change (Yin, 2007). By using a case study method for this research it is possible to undertake an extensive exploration of the research questions by being able to gather information from a number of sources (Meredith, 1998). In this research the data collected from a number of sources will enable comparison of data obtained in addressing the research questions. Furthermore case study data are used to develop a set of guidelines for implementation of MOODLE as a sustainable LMS.

#### **4.4.2 Quantitative – qualitative methodology**

This section details the qualitative and quantitative methods used in developing approaches for this research addressing the research questions stated in chapter 1. The use of qualitative methodology in this research is to gain a deeper understanding of the interactions between users of the LMS. As indicated by Maxwell (1992) qualitative research affords the opportunity to uncover and interpret mechanisms behind behaviours of participants. The construction of meaning for changes in this research necessitates an active process involving the inter-relationship between researcher and participants. Undertaking this form of research implies that any outcomes will contain the views of the participants and also the subjective views of the researcher who translates the participants' perspectives. In this respect this helps generate meaning for what has occurred and helps articulate the *case* that is being studied.

Qualitative data methods are used in this research to illuminate user's patterns of use helping establish boundaries as they apply to this school context. MOODLE as the LMS operates throughout a twenty four hour period and usage data can be used to establish patterns for users of the LMS. In the context of this research, such data is needed to explore the evolutionary usage of the LMS within the school site and using statistics derived from data logs enables the researcher to measure phenomena or behaviours in an objective manner (Bettis & Gregson, 2001). Within this research data collection enabled examination of the distinguishing characteristics of interactions, the real usage and where possible identifying the limits of use (Weber, 2004).

In addition, the use of quantitative data methods enabled this researcher to garner insights into the decisions participants made regarding resource usage within the LMS. For instance it provided evidence for teachers about what students see as valuable in helping them complete a course of study. The data logs obtained helped in comparing what users may think is occurring within the LMS with the data logs. This usage data provides evidence of both global trends and specific resource usage patterns within a course.

#### **4.4.3 The use of case study methodology in this research**

This section provides the rationale of the use of case study methodology and its use in this research. Yin (2003) defines the case study research method as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used” (Yin, 2003, p. 23). As noted above, case studies enable a contextual analysis of a limited number of events or conditions and the associated relationships that can occur. In this respect, a case study enables the researcher to focus on a contemporary phenomenon within a real life context and when little is known about it (Yin, 2003). Yin argues a “major strength of the case study data collection is the opportunity to use many different sources of evidence” (p. 91). Case study research used in this research has its focus upon describing the implementation process and operation of the LMS and also explores the relationships that support and maintain the use of the LMS at the school.

Through using case study methodology, it is possible to gain an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research. This is true of the implementation and adoption of MOODLE at this site. Individual decisions taken are contrasted with the wider adoption and development of MOODLE. The case study methodology also allows a contextual analysis of a limited number of events or conditions and explores how these interrelate. For this research a key strength of the case study method is that multiple sources and techniques in the data gathering process can be used. In this research, case study methodology is used to describe changes that occur at this site in response to implementing MOODLE as this school sites LMS. Limitations (Yin, 2003) are addressed through the use of multiple sources of qualitative data (focus groups, research diary, school reports) and quantitative data, (data logs; usage statistics) and the analysis of the collected data cross checking the findings. These data collection methods are presented in table 4.4.

## **4.5 Research design**

### **4.5.1 Introduction**

The research design chosen for the research has taken into account factors that may contribute to the context of the site. As outlined in chapter 3, there has been limited research on the use of a LMS deployed within schools and its effect upon the practice of teachers and students. Case study methodology is used to explore this deployment and allow evidence to be collected and interpreted as it applies to this case.

This context is developed in part by the members of the school community but is also developed from the policies articulated by EQ that govern school ICT practice as noted in chapter 1 and chapter 2. The political and social issues present within schools as considered in chapter 1 and chapter 2 may influence the interactions between teachers, students and administrators within this site. As a consequence there are policies and procedures that are mandated by EQ and not within the control of the individual teacher. These conditions were considered as part of the research design.

An important consideration within the Action Phases of the research, as detailed in section 4.5.2 below, was to establish voluntary participation for adopting the LMS. This was deemed necessary as the research questions seek to identify the conditions necessary for adoption and governance. The school's administration confirmed this aspect stating that this research was free of systemic EQ ICT policy initiatives. This was a *key* issue as the case study attempts to examine the conditions within a school that enable developing an LMS. The focus of this research was not an exploration of the influence of EQ policies upon practice. The remainder of this section presents the design considerations and the Action Phases developed for this research.

### **4.5.2 Selection of research design**

In this research it was decided to explore the implementation of MOODLE over a number of phases as shown in Table 4.3. This approach was adopted following a synthesis of examples of reported case studies on the use of LMS (BECTA, 2009a; OECD, 2007) and a synthesis of the literature dealing with research methodology (Klein & Myers, 1999; Yin, 2003; Denzin, Lincoln & Giddens, 2003). The Action Phases that are used reflect the ideas presented in chapter 2 and also the literature considered in chapter 3. The Action Phases represent an approach that allows

data collection, discussion and refinement of design informing the next phase. This was deemed essential in helping engage staff in trialling MOODLE as part of their classroom practice.

Table 4.3  
*Research Action Phases*

Phase	Description	Research Questions
Initiation Phase	This phase is concerned the potential and benefit of implementing a school-based LMS. Selection of a trial cohort of student to trial the LMS.	RQ 1.1 RQ 1.3. RQ 3.1
Selection of LMS	Evaluation of MOODLE, Sakai and Blackboard using Alvarado (2004).	RQ 1.1 RQ 1.3.
Action Phase 1	Development testing of the LMS – using a trial group to co-design learning experiences. The results obtained were presented to the School Management Group.	RQ 1.2 RQ 2.1, RQ 2.2
Action Phase 2	Whole school trial of the LMS. Faculties are invited to nominate staff to develop a selection of trial courses for students.	RQ 1.1 RQ 1.2 RQ 1.3. RQ 3.1, 3.2
Action Phase 3	Whole school implementation of the LMS. Examine sustainability.	RQ1.1, RQ1.2 RQ 3.1, 3.2
Technical documentation of the stages of research	Document technical expertise and practical course development support. This documentation runs parallel through the research phases.	RQ2.1 RQ 2.2 RQ 1.3.

These phases help to describe the implementation of MOODLE and provide distinct markers for each of the Action Phases.

### *The initiation phase*

This phase concerns the genesis of using MOODLE. As described in chapter 2 conditions existed that influenced the decision to implement MOODLE. This phase also considers the sequence of events that led to a cohort of students being identified.

### *Selection of an LMS*

This phase was informed by two issues

- student learning needs and demands
- technician skills and knowledge.

Students identified technology and the ability to choose applications as a way of engaging in learning. This idea was used as a base to research the available LMS platforms and the capacity for the LMS to be scaleable.

### *Action Phase 1 Development testing of the LMS*

The cohorts of students identified in the Initiation Phase were asked to participate in a trial of the chosen LMS, MOODLE in a dedicated classroom with dedicated teacher, teacher aide and technician.

### *Action Phase 2 Whole school trial*

This phase arose from the findings of Action Phase 1. In this phase mainstream classes incorporated LMS as part of the classroom environment. Resources were made available for students using the web portal. Staff were invited to attend professional development sessions. Staff involved during this phase were interviewed regularly to identify how students and teachers worked together in selecting and creating resources for the class groups. Data collected during this Action Phase provided a basis for developing professional development and selection of staff to adopt roles within the LMS helping maintain and develop the site. This was important as it helped inform Action Phase 3 which has a focus upon examining sustainability.

### *Action Phase 3 Whole school usage*

This phase focused upon further developing the LMS. All faculties and staff were offered courses and professional development if they wanted to use the LMS. Focus group interviews collected data helping to evidence what factors contribute to the LMS being sustainable. Teachers', students' and administrators' interview data was collected. The results of interviews helped to create an ongoing professional development cycle for staff and also helped identify further technologies for the site.

### *Technical documentation of LMS use*

The school technician documented the MOODLE versions and the associated technical framework that developed parallel with the research. A technical diary was maintained noting software versions for operating systems used with MOODLE. Problems and successes were also noted and scripts written that helped to automate processes were documented. This data also included notes on the use of modules and plugins selected for use within MOODLE.

The staged approach described above represents the Action Phases of this research. Action Phase 1 was the only phase that had a defined timeline following a school semester of six months duration. The other Action Phases did not have specific timelines as participants all adopted and created practice at differing points.

## **4.6 Data collection methods**

### **4.6.1 Introduction**

In this section the methods used for data collection are presented. Table 4.4 summarises the data collection methods used in each Action Phase.

Table 4.4

*Data Collection Methods Used in the Research Phases*

Research Phase	Data Collection Methods	
	Qualitative	Quantitative
Initiation Phase	Focus groups Research diary	
Selection of LMS	Evaluation of MOODLE, Sakai and Blackboard using Alvarado.(2004), and FAVE (BECTA, 2008)	Quantitative evaluation data from the literature (Humbolt State University, 2007) and the technical and software notes from the different LMS packages
Action Phase 1	Research diary Focus Groups	Site usage reports Course activity reports Course data logs Participation reports Summary course usage logs
Action Phase 2	Focus groups Research diary	Site usage reports Course activity reports Course data logs Participation reports Summary course usage logs
Action Phase 3	Focus groups Research diary	Site usage reports Course activity reports Course data logs Participation reports Summary course usage logs
Technical documentation of the LMS	Focus groups Research diary	Site usage reports Server specifications

### *The initiation phase*

Data during this phase was collected using a research diary. Notes were made of the initial conversations and the steps taken in formulating the steps undertaken and the decisions made toward implementing an LMS. Focus groups were used during this phase. Notes from management meetings were also kept. Research diary notes were kept concerning the student experiences within the class.

### *Selection of an LMS*

As described in chapter 2, three LMS platforms were identified as possible for the site. Sakai, MOODLE and Blackboard were researched by the school technician and the HOD Student Services, and the features of each were compared and discussed with respect to their applicability for use at this site. Decisions made on each were recorded in the research diary.

### *Action Phase 1*

A research diary was maintained for this period. Data was also collected using the tools contained within MOODLE to generate logs data about the site. This is described further in section 4.6.2. Student and teacher focus groups were also conducted.

### *Action Phase 2*

Data during this phase was collected using a research diary. Notes were made concerning the conversations with staff and students about the uses of the LMS. Focus group sessions were recorded and transcripts with classroom teachers about the incorporation of functions from the LMS in instruction were detailed. Data was also collected using the tools contained within MOODLE that logs data for the site.

### *Action Phase 3*

A research diary was used to record details concerning the decisions as to *why* teachers chose to use the LMS. Focus groups sessions were held to establish MOODLE features used and to identify which aspects of MOODLE teachers and students considered as useful. Data was also collected using the tools contained within MOODLE that logs data for the site. These included data logs from within courses and for specific modules and plugins to establish functions used within MOODLE.

### *Technical Documentation*

The technical diary recorded details concerning the following:

- Operating systems – open source products and their versions used in the operation of MOODLE on the server
- Security measures – recording the code lines written for automating functions enabling automatic upgrades via CVS and other server consideration
- MOODLE upgrade procedures – documentation of MOODLE version changes
- Modules and plugins selected – implementation notes from staff detailing features requested and responses to updated MOODLE features
- Problems and successes – notes of how to install modules and plugins
- Server requirements – notes stored concerning updates from MOODLE.org suggesting changes for operating systems or server requirements.

## **4.6.2 Data logs**

### **4.6.2.1 Introduction**

Within this research a series of computer generated data logs were maintained for the duration of the research. The data logs documented the usage of participants from when they logged into MOODLE through to logging usage within courses and documenting individual resource access. Data logs were used to identify and develop evidence of usage for the administrators, teachers or students within MOODLE. Resource access by all users is time and date stamped and this provides information concerning frequency and time of use. This enables the documentation of *real* site usage and provided the base for data analysis.

### **4.6.2.2 Purpose of data logs**

In this research data logs within MOODLE were used to track the level of MOODLE access and usage of individual users. This is achieved via the user's name that each user is assigned within MOODLE. All users are assigned a unique username when they enrolled which only a site administrator can change. The username allows the data logs to be created using an identity tag and allows tracking of data to establish the level and extent of use by individual students, a class, or a user.

The level of access and usage data in this research was obtained from the following user groups:

- administrators

- teachers
- students.

Data logs were also used for the following purposes:

- identification of active or dormant courses
- quiz data from formative assessment.

This enabled analyses of some of the features used by students and teachers and also helped to frame questions for focus group sessions with teachers.

Within the context of this research the types of data reports that were generated for the purposes of this research are briefly considered below.

***Site statistics:*** Computer generated logs are an integral function within the MOODLE platform. This allows a range of quantitative data to be obtained in the form of data logs covering a number of aspects about users' access and the types of LMS features used. For example data can be made available for all users and the function they have accessed. From a user's initial login, data logs record user path and document resources or functions accessed by them. Table 4.5 presents a *snapshot* of user access, by role, for a one week period. The numbers represent the number of times a user from each group has logged into the MOODLE site. This data was deemed important within this research for establishing MOODLE usage profiles.

Table 4.5  
*Sample Global Site Data Logs*

Period ending (day)	Teacher	Administrator	Student
8-Apr-09	109	99	329
7-Apr-09	290	19	462
6-Apr-09	25	37	51
5-Apr-09	0	0	13
4-Apr-09	38	34	96
3-Apr-09	68	0	127
2-Apr-09	27	26	106
1-Apr-09	64	28	120

The sample log data in Table 4.5 shows usage data for a week, but likewise can be generated for a month or back as far as a one year period. These types of logs have been used in this research for contrasting results obtained from focus group responses and notes made in the research diary.

Figure 4.1 presents this data graphically for the same one week period during April, 2009. The roles of individual users are presented as lines of differing colours: red is a teacher, blue is a student's activity, green is a site administrator. The black line is the aggregated activity for the site that represents all users. Such data can be useful when used over a longer period in examining usage patterns and site development. This type of data was used in establishing usage trends for each user group. Figures can be accessed for any period of time.

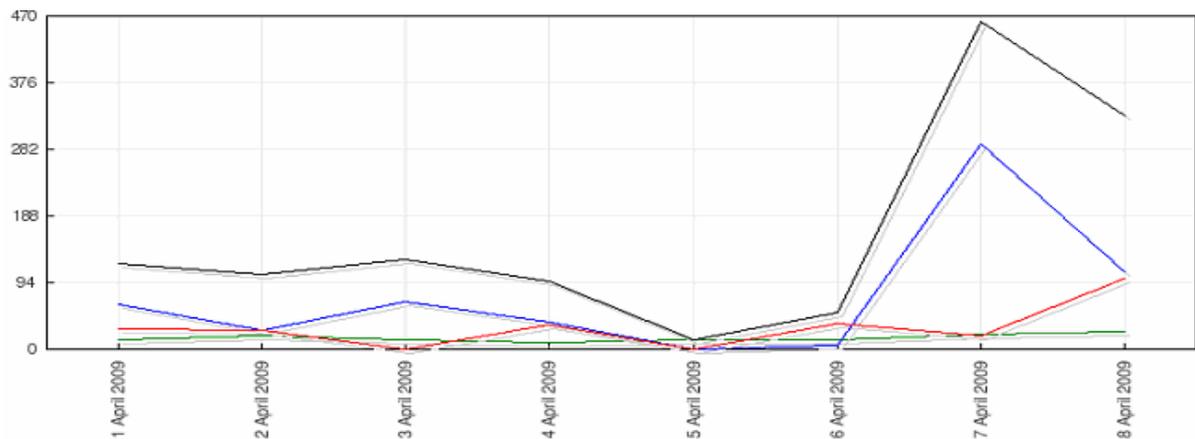


Figure 4.1 Sample graphs of data logs for one week April 2009.

The vertical axis represents the number of individuals' access to MOODLE and the horizontal axis represents the dates the data log was accessed.

### ***Course logs***

Another form of data used in this research is the use of course data logs. These logs show activity within each course and linked an individual user and the resource being accessed. This feature can be used to provide information concerning the type of resources being used within a course and the frequency of use. This helped the researcher to identify features that were used often within a course and contrast these with features that were not used frequently. This information can be used in the identification of functions that were deemed useful by the users. This provided the means for data to be contrasted with responses from focus group sessions. Table 4.6 shows a sample of course data obtained using the course log function. It can be seen from the table that this feature provides details of a user's time of access, the computer used, the researcher's name and the action by the user and the title of the information accessed. The columns within Table 4.6 show the date of access, the computer used for access, the person and what action was taken on the specific resource.

Table 4.6

*Sample Course Log for a Teacher User*

Time	IP Address	Full name	Action	Information
Tue 1 September 2009, 10:55 PM	121.222.133.135	Greg Wilson	course view	Year 9 Trade winds Course 2009
Tue 1 September 2009, 10:54 PM	121.222.133.135	Greg Wilson	user view	A student
Tue 1 September 2009, 10:54 PM	121.222.133.135	Greg Wilson	user view all	
Tue 1 September 2009, 10:54 PM	121.222.133.135	Greg Wilson	course view	Year 9 Trade winds Course 2009
Tue 1 September 2009, 10:54 PM	121.222.133.135	Greg Wilson	assignment view submission	globalisation essay
Tue 1 September 2009, 10:54 PM	121.222.133.135	Greg Wilson	assignment update grades	

This was an important source of data to establish the LMS features the teacher group considered most used by students. This type of data was used to cross check findings from focus group sessions with staff concerning features used and the level of their use. The log data information was not always in agreement with focus group responses regarding the level of use and MOODLE features used. The data logs were contrasted with diary notes to identify LMS resources and functions that were used within courses.

***Activity reports for specific resources***

Another data collection feature used in this research is the use of *activity reports* for specific resources. This feature can be used by a teacher to examine resource usage for their course(s) within the LMS. Within this research activity, reports helped to evidence findings made from focus group participants. This was important as the data provided from activity reports states the frequency of access for resources and the amount of access for an individual. Teacher and student usage data could be collected from individual courses allowing for a profile of usage to be established for *like subjects* from within a faculty and checking specific functions accessed across the site. These results help to provide evidence for addressing the research questions.

Table 4.7

*Activity Course Report Data***BIOLOGY year 11**

Computed from logs since Tuesday, 25 March 2008, 03:23 PM.

Activity	Views	Last access
 BIOLOGY ONLINE DICTIONARY	2	Friday, 31 October 2008, 05:11 PM
 Biology textbook on-line. This page leads to the index where you can search for a topic alphabetically.	4	Sunday, 15 March 2009, 08:48 PM
 News forum	-	
 On-line access to "New Scientist" journals. Excellent resource for assessment tasks.	3	Wednesday, 29 October 2008, 09:28 AM
 On-line access to "Nature" - a weekly scientific journal. Useful for assessment.	4	Friday, 31 October 2008, 05:09 PM

Table 4.7 provides an example of access by students for a particular resource which was contained within a course. By clicking in the “views” section enables the identification of the student accessing the resource. This can be cross checked using other data logs. It demonstrates the number of students that have accessed individual resources and when they were accessed. Each resource also has its own usage logs attached to it and which can be used to identify individual students that accessed the resource and evidence of the duration and frequency of access. This type of data can be used to identify students who are using the resources and also help identify student who are not utilising the resources within the course.

***Participation report***

An example of a participation report is presented in Figure 4.2, which illustrates the entry page for a teacher wishing to examine participation usage data. The report allows for a range of data to be presented. The top box shows the “activity module” from which any specific resource active within MOODLE can be accessed. This feature allows the teacher to access specific information if needed. The next box “look back” allows the teacher to select data logs for a defined period like a week, a month up to year. The next box “show only” allows for the user group information to be displayed. The final box the “show action” box allows the posts or views to be displayed. The teacher can view data for all users or refine the search to an individual group (e.g. students).

Further the data can be examined for a specific day or a longer period of time. The entry page outlines the drop down lists that identifies the specific records for users. This feature enables the researcher and other users to access usage data from a course using a search feature that can access specific data for a teacher, a student or an administrator. The data from participation reports was used in this research to identify usage patterns by

- students
- teachers
- administrator

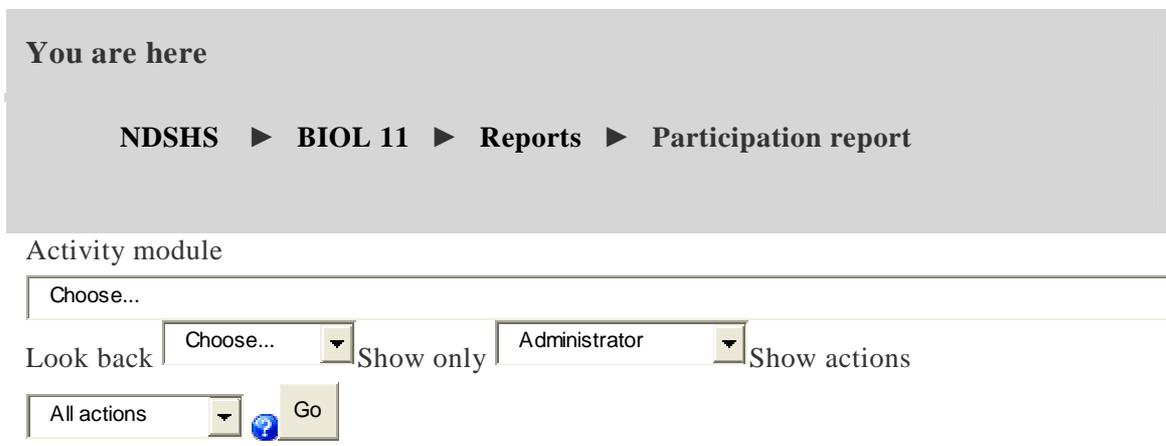


Figure 4.2 Participation report data entry page

**Course resource statistics:** The “course statistics” MOODLE feature enables the researcher, and other users to view the usage on their site. Data is available for global site usage through the administrator tools. In this research the course resource statistics are used to cross reference data obtained from focus groups sessions. This was done by grouping specific answers from focus group responses with statistical data obtained and checking whether or not claims made were accurate. In this way it is possible to check the fidelity of self-reported data obtained by informants using qualitative methods. The questions used are presented in Table 4.10. Data logs obtained in each of the Action Phases were used to examine user trends such as type of resources used and the frequency of access for a specific resource.

Table 4.8 is a sample data log for site access for the period 1<sup>st</sup> July 2008 to 1<sup>st</sup> April 2009. The data from these logs is used to examine the number of individuals who assessed the total site from within each of the groups. The figures within the column represent the number of individual users

for that month period only. This was important for the research as this feature enabled the examination of the number of visits to the site of specific users within the groups and compared usage data from the group and user trends. The data contained in Table 4.8 allowed usage to be compared with assessment period within the school. The table generated within MOODLE itself is hyperlinked allowing access to specific resources if needed to quickly identify specific resources being accessed.

Table 4.8

*Sample Data Logs Representing the Individual Total for Site Access for Students, Teachers and Administrators*

---

Period ending (Month)	Student	Teacher	Administrator	All
1 April 2009	105	0	24	129
1 March 2009	230	16	3	249
1 February 2009	0	10	0	10
1 January 2009	0	0	3	3
1 December 2008	81	1	0	82
1 November 2008	176	17	0	217
1 October 2008	163	38	10	211
1 September 2008	226	22	3	249
1 August 2008	220	16	5	241
1 July 2008	150	20	1	171

### **4.6.3 Focus groups**

#### **4.6.3.1 Introduction**

As shown in Table 4.4 the focus groups' data was obtained during Action Phases 2 and 3. The key advantage of the focus groups was the interactions among the participants in the discussions can be related to the topic of the study only when the focus group is directed to do this (Olsen, 1995). The interaction within the group may help individuals open up further than if interviewed separately. Lewis (2000) asserts that focus groups yield a more diversified array of responses than a survey or questionnaire. Using focus group methodology is appropriate within this research because of the capacity to explore the opinions of the participants. This is an important consideration for this research as it helps to generate insights from participants (Kitzinger & Barbour, 1999) not easily obtained using other data collection tools. Another advantage of using the focus groups is the ability to frame questions using contextual language to help develop clarity in structuring questions for participants.

#### **4.6.3.2 Purpose**

The purpose of using the focus groups for data collection in this research was twofold. Firstly focus groups were used to examine in depth what participants considered as important in developing teacher practice using MOODLE. Secondly, quantitative data obtained was presented at the focus group meetings and this data was discussed by participants. The responses helped capture what participants' interpreted as important; specifically highlighting the similarities and differences, from the data collected using site statistics. Thus the use of the focus group responses helped to *liberate* ideas concerning the benefits or otherwise of MOODLE at the school.

For this research, an important consideration is developing understandings about the considerations users made in determining to use MOODLE. Specifically, the use of focus groups provided the opportunity to have a group of participants in the research interacting together. This approach helped to extend the depth of understanding concerning the reasons users decided to use MOODLE.

#### **4.6.3.3 Approach**

In addressing the research questions and using the review of the literature outlined in chapter 3, the researcher identified the five markers. The markers are summarised in Table 4.9 below.

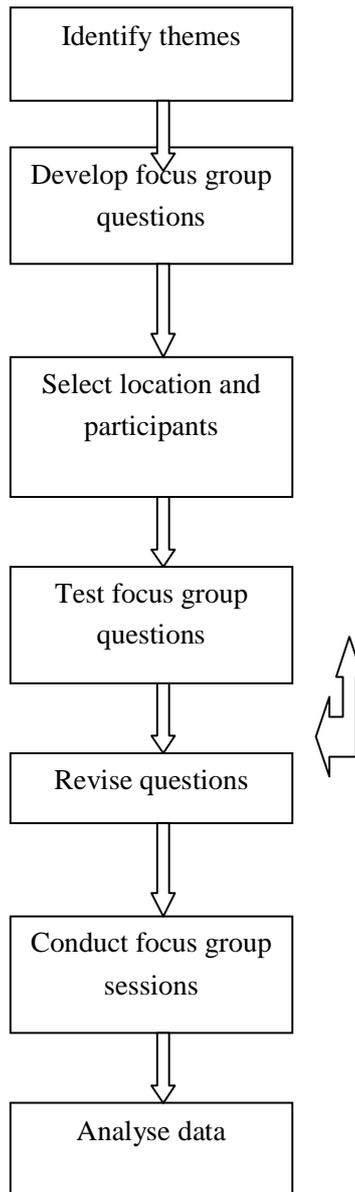
Table 4.9

*Markers Identified in the Literature*

---

Theme	Description	Reference
Networks	Development of user networks and the collaborative actions that occur within the school site.	Müller, Sancho, Hernández, Giro, Bosco, (2006); Hennessy and Deaney (2004)
Adaptations	Adaptations of practices that incorporate ICT of users involved in the use of the LMS	Sévigny and Prévost (2006)
Scalability	The ability of the LMS to incorporate functions desired by participants and have the capacity to grow	Hennessy and Deaney, (2004)
Governance	The willingness of participants to undertake tasks or roles willingly supporting the development of the LMS	Ballantyne (2003)
Site Activity	Usage of the LMS both during school time and out of school hours.	MOODLE data logs

The above markers were used as a reference point for the development of the focus group questions which is discussed in the following section. The process undertaken to identify the themes for the focus group sessions and the analysis of focus group data is presented in Figure 4.3. This process outlined in Figure 4.3 shows the sequence of actions in which focus groups questions were developed.



*Figure 4.3* Focus group instruments development

The development of questions asked in the focus groups was a negotiated process between the researcher, the school technician and the Principal of the school. These discussions resulted in a series of key ideas that reflect the research questions. Specifically these included;

- Who are the groups using MOODLE within the school?
- How is MOODLE being used by the groups within the school?

- What are the changes that can be identified and how does this contribute to sustainability?

The questions were trialled with selected staff members before using them in focus groups. This allowed the researcher to rehearse the presentation of the questions to develop confidence and familiarity in their presentation. The locations used for focus groups sessions were selected and the participants were invited to attend. The staffs that tested the questions were not part of the focus group.

All focus groups sessions were held at Noosa District SHS. The teacher focus groups sessions were held after school finishing between the hours of 4.00pm and 5.00pm. Student focus groups sessions occurred during school time because a high proportion of students traveled by bus and could not stay after school. These focus groups were held during the long lunch period of 55 minutes. Group membership for the focus groups sessions was based on research groupings. The teacher group's membership was voluntary and participants were selected if they were available within the timeslot.

The analysis of the focus group data was a systematic and replicable process. Responses were examined against prior session and trends noted. Anomalies were also noted for later analysis. One example was a student who maintained she used quizzes for revision yet log data failed to support the claim. It was important that the focus group results be a reliable and a valid reflection of the way the individuals and the groups felt about the ideas explored. A number of steps were taken to ensure the validity of the results:

- At the conclusion of each focus group, there was an open summary discussion that went over the main points discussed and gave the opportunity for participants to agree with the summaries generated.
- Transcripts from recordings were generated by the researcher of all focus groups and coded by the researcher.
- The results from the focus groups were available for members to comment upon.

The focus group method used in this research was semi-structured. This allowed for some comparable data to be collected (Lewis, 2000). This was in the form of responses to same questions that were asked to focus groups through the Action Phases. This allowed comparison of data from responses made over time, helping establish changes for users. The focus groups

approach used allowed the telling of the *stories* of teachers developing their knowledge about the use of LMS as part of their teaching practices.

#### 4.6.3.4 Procedure

All focus groups sessions had six to eight participants, as between six to twelve participants is considered as optimum for appropriate focus group discussions (Lewis, 2000). Development of the focus group questions drew upon the work of Morgan and Krueger (1998) and the final questions are presented in Table 4.10. The questions were the same for all groups.

Table 4.10

*Focus Group Instrument Question Organisation*

Function of Questions	Question	Research Question
General questions	1. What is your role at this school?	RQ1
	2. What level of computer skills do you believe you have at this point in time?	RQ1.1 RQ 1.2
	3. Have you used a learning management system before?	RQ1.3 RQ 2
Transition questions	4. How are you using MOODLE with your class?	RQ 2 RQ2.1
	5. Identify functions of MOODLE that you enjoy using within the classroom environment?	RQ 2.2
Key questions	6. Has using MOODLE affected the way you think about how new technology can benefit this school community?	RQ1 RQ 2
	7. What have you enjoyed most about using MOODLE?	RQ 3
	8. What have you enjoyed the least about using MOODLE?	
Final questions	9. When learning new skills and sometimes experiencing frustration, what brings you back into a positive frame of mind and keeps you going?	RQ1 RQ 2
	10. Of the items we discussed that enable LMS usage for students and teachers, which one is the most important to you?	RQ 3

### ***General questions***

The structure of the questions moved from general questions about their role within the school to specific questions about the LMS. Initial opening questions introduced the general topic of discussion and provided participants with the opportunity to identify their role within the school and outline any experiences using an LMS prior to this research.

### ***Transition questions***

Transition questions were asked and these dealt with identifying the level of knowledge participants had about MOODLE and the functions it contained. These questions were selected because they helped participants collaborate by sharing information with each other about MOODLE functions. This was deliberate to instill a measure of comfort with terminology and describing usage within the classroom. These questions helped address the main research questions identifying changes in teacher practice and outline usage pattern. The opportunity within these broad questions allowed discussions to follow particular likes and dislikes of participants. This helped develop a detailed picture from participants regarding their experiences using the LMS.

### ***Key questions***

Key questions related to the use of MOODLE. These questions targeted the beliefs of users concerning the development of the school's community using MOODLE. Further questions asked sought to identify the features of MOODLE that users felt made MOODLE a usable platform or the features they felt did not make MOODLE an option for use. These questions specifically relate to the research questions as stated in chapter 1.

### ***Final questions***

The final questions focused on the exploring underlying reasons for incorporating MOODLE into personal practice. Respondents were also asked to identify, again, key features they enjoyed about the use of MOODLE. This question allowed prior responses to be cross checked.

## **4.6.4 Research diary**

### **4.6.4.1 Introduction**

From the commencement of the research, the participant researcher maintained a research diary for this investigation. The diary was an important research tool as it documented over time responses from user groups and noted the growth of skills of some individual users through the Action Phases. This proved beneficial in examining *how* individuals perceived the LMS use and benefit over the research phases.

### **4.6.4.2 Purpose**

The content of the diary includes written accounts of all stages of the research. The purpose of using the diary was to maintain a record of the initial development phase and each of the Action Phases. The diary was structured using the research “markers” identified in chapter 3 as an organizing framework for recording data.

### **4.6.4.3 Use of the diary**

Documented in the diary are the features that help describe the changing nature of the LMS over the data collection period. In addition technical upgrades of the site have been recorded including dates and MOODLE version changes of the LMS. This data has been collected to illustrate the ability of the site to evolve incorporating newer versions of MOODLE. It also provides evidence for the reliability of the upgrade process in terms of any data lost and how teachers incorporate new features from new releases within their classes. This data collection was used in conjunction with data collected concerning modules and plugins sourced from the parent MOODLE site authored by third party programmers.

The modules and plugins selected by staff indicate and illustrate growth of the site and the changes in functions used by participants. The research diary also includes interview records with participants from the groups identified in the research. These records are notes from conversations with participants or comments that occurred in passing or from students that were in classes. These notes help with establishing evidence associated with the research questions described in chapter 1.

#### 4.6.5 Interviews

Following the focus groups, interviews were conducted periodically with individuals from each research group of users. The purpose of the interview was:

- to verify the themes as identified in the literature and those which emerged from the focus group data
- to seek further clarification on the above themes.

#### Interview data analysis

Written notes were kept for each interview. The collected data was examined to identify common themes and recurring issues. The fact that some of the issues did not come forth in some of the data was noted as was the divergence in the views which surfaced. The overall themes and issues were then put together. It was possible to identify the themes and issues emerging from the interviews to be consistent with the findings of the literature reviewed in chapter 3. The themes developed from the literature are presented in Table 4.9.

The interviews provided substantial information relevant in the context of MOODLE use both within the classroom and the uses for MOODLE by students from home. The identified themes and issues and the results from the data analysis are discussed in chapter 5 of this dissertation.

#### 4.7 Study sample

##### 4.7.1 Selection of sample and size

Teachers, students and administrators were involved this research. As such the sample used for this research was drawn from these three groups. As is shown in Table 4.11 the number of individuals is presented for each of the Action Phases developed for this research.

Table 4.11  
*Number of Participants per Research Phase*

---

Research Phase	Number of Students	Number of Teachers	Number of Administrators
Action Phase 1	14	2	1
Action Phase 2	80	12	2
Action Phase 3	762	70	4
Technical Documentation	1244	82	6

**Students** The number of students participating in this trial changed as the study moved from the initial cohort described in Action Phase 1. As discussed in chapter 2, this phase identified a cohort of problem students who after an interview participated in a classroom that used MOODLE.

In Action Phase 2 eighty students participated. Students' focus groups sessions were generated for the year levels 8 - 12. This was to identify if usage patterns changed as students moved up year levels. There were two focus groups:

- the first consisted of representatives from Grade 8 and Grade 9 with 8 members from each year level
- the second consisted of representatives was from Grade 11 and Grade 12 with 8 members from each year level

This number of eight remained constant as this size was manageable for the collection of responses to the focus group questions. The size of the group and the groups' composition of males and females were roughly equal.

**Teachers** The number of teachers involved in this research increased over the duration of the investigation. Initially in Action Phase 1 two teachers participated. Action Phase 2 twelve teachers utilised MOODLE within their courses. This number grew to over eighty staff after Action Phase 3. During Action Phase 3 two focus groups of eight staff in each were established to explore themes involved with the research.

**Administrators** There was one site administrator in Action Phase 1 and in Action Phase 2 there were two administrators. During Action Phase 3 there were five administrators with the number rising to six by the end of the data collection period.

#### **4.7.2 Description of sample**

##### ***Students***

The samples of students used in this research were from across all year levels at this school. All students had access to computers and the Internet at home and identified they used Face book, MSN or Myspace at least once per week.

##### ***Teachers***

The samples of teachers involved in this research were drawn from full time staff working at Noosa District SHS. These teachers all had a minimum of ten years experience in teaching in a

variety of schools within Queensland. From the sample only three teachers had limited experience using web portals. These were teachers who had accessed EQ's Learning Place at other school sites.

### ***Administrators***

MOODLE administrators at this school site were volunteers that had self nominated after using MOODLE during Action Phase 2. They were teachers who had learnt the basic functions and felt confident in learning some of the functions that help maintain the site. The technician was also an administrator for the site.

## **4.8 Research ethics**

The initial approval for this research was granted from Education Queensland using the guidelines established for research. Ethics approval was then sought from CQ University as part of the research process associated with this degree. The research followed the principles advocated in the Code of Ethics for Research developed by the Australian Association for Research in Education. Ethical clearance was obtained from the CQU Human Research Ethical Clearance Committee (Project number H08/10 – 055). To comply with the Ethical requirements, the researcher in order to protect the anonymity of the focus group sessions and interviews with participants, used pseudonyms.

## **4.9 Summary**

This chapter has identified the interpretive paradigm as the means for undertaking this research. This reflects the nature of the research and the views held by the researcher on the nature of the school context. Also the chapter has outlined the data collection methods used in this case study. This next chapter presents the results from the data collected.

# Chapter 5 - Results

## 5.1 Introduction

The previous chapters have provided a background for this research, examined the literature and outlined the research Action Phases associated with the implementation and operation of MOODLE, and outlined the research design and data collection methods. This chapter presents and discusses the results from the data collection for each of the four Phases of this research. Also presented within this chapter is the data collected from the different methods. This data is considered in terms of measures of sustainability, or the markers of sustainability.

## 5.2 Method of presentation of results

Results presented in this chapter follows the structure used for the research Action Phases presented in chapter 3. This approach allows for the detailed presentation of results as represented by each of the Phases. Table 5.1 presents the Action Phases, the participants and the data collection methods used in the research. Table 5.1 further provides an overview of the numbers of participants within each phase and helps establish the growth during each phase and the resultant change in participants. The table also presents the methods for collecting data during each phase. Results from these Phases are considered further in section 5.3.

*Table 5.1*

*Action Phases, Participants and Data Collection Procedures*

Action Phases	Participants	Data Collection Procedures
Initiation Phase Selection of LMS	<ul style="list-style-type: none"> <li>• 1 teacher</li> <li>• 1 trial class</li> <li>• 1 admin</li> </ul>	Data logs Course statistics Research diary
Action Phase 1 - Development Testing Admin; Students; Teachers	<ul style="list-style-type: none"> <li>• 14 students</li> <li>• 2 teachers</li> <li>• 1 admin</li> </ul>	Data logs Course statistics Research diary
Action Phase 2 - Whole school trial Admin; Students; Teachers	Focus Groups <ul style="list-style-type: none"> <li>• 16 students</li> <li>• 16 teachers</li> <li>• 2 admin</li> </ul>	Observations Data logs Course statistics Research diary Focus Groups
Action Phase 3 – school implementation Admin; Students; Teachers	Focus Groups <ul style="list-style-type: none"> <li>• 16 students</li> <li>• 16 teachers</li> <li>• 6 admin</li> </ul>	Observations Data logs Course statistics Research diary Focus Groups
Technical documentation of NDSHS MOODLE	Interviews - 1 Technician	Research diary

Table 5.2 presented below outlines the markers summarised at the end of chapter 3. These have been used as organisational headings for data gathered concerning aspects of sustainability. The markers in turn provide a framework for exploring the research questions outlined in chapter 1.

Table 5.2  
*Sustainability Markers and their Research Theme*

Marker of Sustainability	Research Marker examined
Networks	Networks as a marker in developing supportive practice. Inter-relationships between students, their teachers and site administrators to examine the impact these had in developing functionality, course design and support structures between groups.
Adaptations	Teacher practice using ICT classrooms as a marker to highlight the changes made by embedding ICT within learning activities.
Scalability	This theme explored how a site <i>grows</i> in response to needs of users.
Governance	Examination of the impact of site-based governance using an LMS. Here the LMS facilitation and changes made for its operation are documented.
Site Activity	Site Activity data logs are examined providing evidence of the decisions made that impact upon classroom practice and the impact upon the sites development.

The research questions have as their focus the identification of aspects needed in developing a site-based LMS. The research questions focus upon the implementation, the development strategies used and the decisions made by its members helping establish and maintain the LMS. Measures or markers of sustainability of MOODLE addressed during the implementation of this LMS with the data collection method used in this research are summarised in Table 5.3.

Table 5.3  
*Data Collection Method Used to Explore Sustainability*

Measure of Sustainability	Data Collection Measure				
	Site logs	External data logs	Focus Groups	Research Diary	Observations
Networks	#	#	#		#
Adaptations	#	#	#	#	#
Scalability	#	#			
Governance	#		#	#	
Site Activity	#	#			

## 5.3 Results

### 5.3.1 Initiation phase

As detailed in chapter 2, the initiation phase for the implementation of MOODLE was a result of a combination of factors that led to the decision to trial MOODLE. School data obtained from the Noosa District SHS School Opinion Survey (2005) and internal database records indicated staff dissatisfaction with some school processes leading up to this decision. These concerns were twofold:

- The level of access for teachers wishing to use ICTs
- Desire to have ICTs application operating on the internal network.

#### 5.3.1.1 Action on School Opinion Survey on use of ICT

Data collected at the end of 2005 revealed staff dissatisfaction with the access to computers and also the functionality available for the use of ICTs within the classroom. The results from the survey are presented in Figure 5.1.

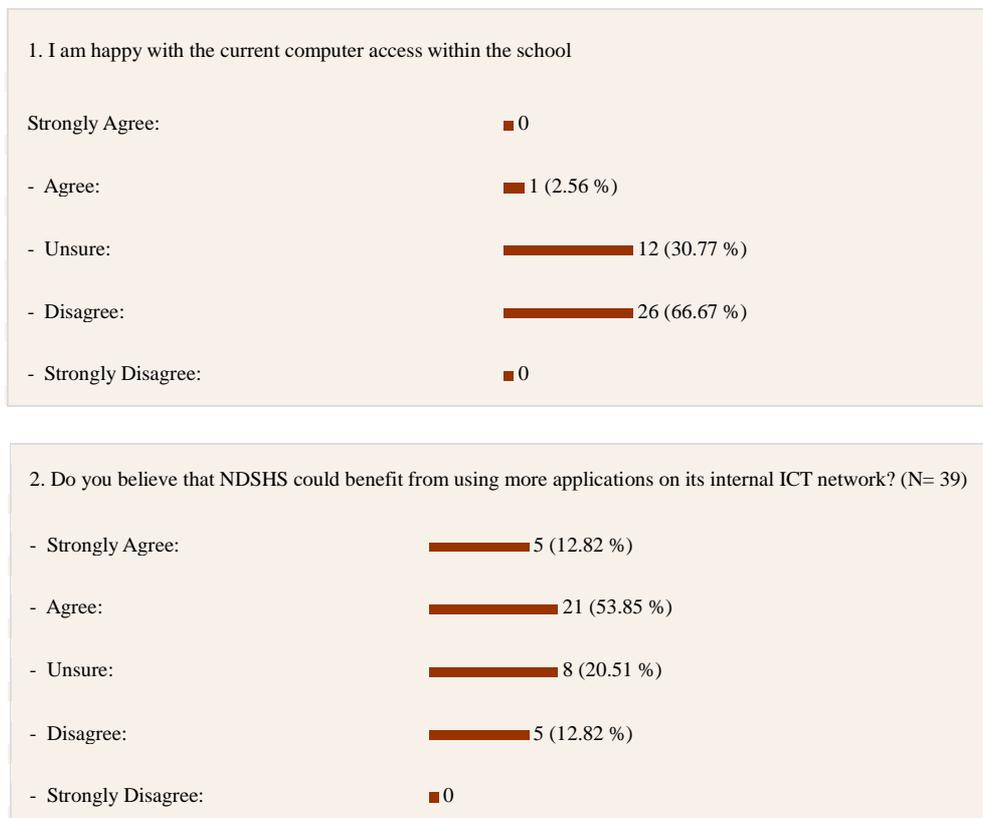


Figure 5.1 School opinion survey results 2005 (N= 39)

A consideration of the result of the responses contained within Figure 5.1 and the creation of the Student Services department, as described in chapter 2, led to a trial cohort being established to explore an alternative way of engaging students in learning using ICTs.

### 5.3.1.2 Responding to the needs of disruptive students

Chapter 2 described the selection of the students for this initial trial during the Initiation Phase.

The main criteria were

- frequent school absence
- poor academic performance in key subjects
- consistent behaviour referrals for a majority of subjects.

The academic results for these students' pre-trial are presented below in Table 5.4. The students' results were obtained from the school database and this was cross referenced with behaviour referral data to determine the criteria for selecting students for the initial trial. Subjects grades in Table 5.4 are presented as A to D grades (A > 80%; B > 70%; C > 50%; D < 50%). It can be seen that the majority of students were achieving C or D grades pre trial with the exception of one student achieving a B standard in Science.

Table 5.4

*Pre-Trial Summary Student Academic Performance Data in June 2005 (N=14)*

<i>Subject</i>	<i>Subject Grades</i>			
	A	B	C	< D
Maths			2	12
English			4	8
Science		1	4	10
SOSE			5	9

### 5.3.2 Action Phase 1: Trial cohort Semester 2, 2005.

In this phase, the Initiation Phase, the students selected trialled MOODLE in a small cohort, with a dedicated room and staff. The main objectives for the trial as determined by the School Management Committee concerned:

- developing confidence by teachers to use ICT strategies for student learning
- developing trust and teamwork amongst student and teacher participants
- promoting student regular school attendance

- facilitating a *virtual classroom*, allowing students input into course design and resources available
- promoting the use of the virtual classroom from home
- using communication tools within the LMS to contact parents with assessment dates and support material.

The academic results of students following the trial presented in Table 5.5. These results indicate that a change has occurred in their academic performance since June. Results for the four subjects show that the students had moved from the D grade into the passing C grade.

Table 5.5

*Post Trial Summary Student Academic Performance Data (December 2005) N = 14*

Subject	Subject Grades			
	A	B	C	< D
Maths		1	10	3
English		1	12	1
Science			9	5
SOSE		1	11	2

Interviews with the students indicated that the students felt the change in results was due to their engagement with the subject matter. One student who performed well moving from all D grades (fail) in previous tests to all passing grades indicated the change in grades occurred as a result of the time he spent using MOODLE. This student identified that it was his increased access and usage of the subject matter using tools available within MOODLE as one reason for his success. "I found I could be a part of the class. Teachers don't let you have a say so it's good. Also I feel good being able to do stuff where I don't have to show my messy writing" (Year 8 student)

Table 5.6 outlines the student comments on the features present within MOODLE during this initial trial period. Table 5.6 concerns only comments on the core features present during this research phase. The core functions are listed in column 1 and are embedded features within MOODLE 1.4.5. Core features were used as a basis to familiarise both students and teachers in developing basic online functions during this Action Phase. The numerical value assigned in column two represents the number of instances of each feature within MOODLE courses. For

example there were 5 separate assignment functions generated to allow students to submit assessments.

Table 5.6

*Student Comments on Functions Contained Within MOODLE Versions 1.4.5*

MOODLE Function	Number of Core Functions	Student responses on MOODLE functionality based on Research Diary Notes
 Assignment(s)	5	Access from home identified as beneficial Don't lose sheets
 Glossary	1	Easy access to look up words for meanings Parent access to help revision
 Forum	2	Allows discussion on resources
 Quiz	4	Useful and helpful in learning content. No pressure, you can work at your own pace.
 Resource (Internet links, learning objects, classroom resources)	35	Liked links to "fun activities" such as games Websites links present saving time negating the need for web search Is visual, not all reading.

The results presented in Table 5.6 suggest that the use of MOODLE allows *convenience* in accessing resources for study. Students indicated that they found the accessibility a positive feature of MOODLE and strongly expressed their satisfaction in helping select activities. The results concerning contribution by students in selecting study material or an activity is revisited later in this chapter. Students also identified the ability to work at their own pace. This aspect was particularly relevant for students in this trial as they worked away from their peer group. Often student work occurred outside of normal school hours. The results from this initial trial informed the development of strategies and ideas that initiated Action Phase 2.

### 5.3.3 Action Phase 2: Whole school trial

This trial collected data over a five month period from February 2006 to June 2006 and represents a full semester's implementation of the LMS across different faculties and year levels.

Professional development for teachers in this trial was accessible through regular sessions offered on student free days and after school one day per fortnight. Teachers involved in the initial trial in Action Phase 1 were made available as mentors for staff new to using MOODLE. Further support was provided for teachers through an allocation of teacher aide time allocated for MOODLE support. Resource development presented in Table 5.7, illustrates the level of use of MOODLE resources at the commencement and end of Phase 2. It can be seen that there was an increase in the development of online resources during this period. MOODLE was also upgraded during this

period incorporating new modules allowing the use of some third party applications like *Hot Potatoes* quiz features.

Focus group sessions used to collect student data, as described in chapter 4 indicated that these functions did help with learning through the provision of a structured environment accessible from home, but was not very engaging. One student noted the following:

“It’s good to go in and do the quizzes but they get a bit boring. I mainly use the blog and communication tool to chat with friends and share resources” Year 9 Student (2006)

Usage patterns identifying access to resources demonstrated that students were attracted to interactive websites or tutorials. Text-based websites with large volumes of text were accessed rarely. Table 5.7 presents data detailing the usage of modules and plugins used within Action Phase 2. The results show strong uptake from students and the introduction of new functions such as the Hot Potatoes Quiz. This may be due to students designing these quizzes as part of their classes. Focus groups indicate some teachers made this feature a task within classes having students make quizzes for their peers. Student usage logs confirm these resources were accessed from home by students. This trend within this Action Phase begins to show students increasing access to resources from home at a similar time to teachers incorporating student designed resources.

Table 5.7  
*Resources Available Within MOODLE Action Phase 2*

MOODLE resources	Version 1.4.5 Feb 2006 Student N= 83	Version 1.5.3 June 2006 Student N= 580
 Assignment(s)	10	24
 Glossary	1	5
 Hot Potatoes Quiz	2	34
 Quiz	4	28
 Resource (Internet links, learning objects, PDF files, MRBS)	35	533
Blogs	67	476

Table 5.7 shows combined results obtained from teachers and students using the LMS for Action Phase 2. Usage logs demonstrate that the primary functions used during this Action Phase were

mainly confined to accessing of websites, Blogs and an increase in instances of revision quizzes. The main resources available for students during this period consisted mainly of web links. This is reflected in Table 5.7 with a total of 533 web links present. This represents a large reliance upon web links by teachers to present content to students when developing MOODLE courses. This reliance upon web links was not reflected in student access in data logs obtained during this phase. Focus groups with teachers identified they were learning to use core functions, like quizzes and linking resources to help students complete assessment tasks. Teachers identified that they accessed other functions, like Hot Potatoes Quizzes, blog functions and glossaries after becoming familiar with what they felt as core modules. Focus groups indicated teachers only sought to improve their development of features after they had had a chance to identify a benefit for students.

Focus groups found that students found these web links often “boring” and teachers’ responses contrast this indicating that they believed that providing the resource for students was appropriate. Student log data suggests pioneered the usage of tools allowing collaboration and sharing of resources and ideas that is the blogs and messaging. Collaborative tools within MOODLE such as messaging and Blogs were available but were not readily incorporated by teachers into initial course designs. Also student log data obtained reflecting course use by students helped to move some teachers from using web links to using students to help generate useful resources for use. This is evidenced from focus groups in the change in use from web links to the use of blogs and glossaries by students or teachers. Table 5.8 identifies the number of MOODLE users from the students, teachers and administrators groups.

Table 5.8  
*MOODLE Users Action Phase 2*

MOODLE Role	Version 1.4.5 Feb 2006 N= 90	Version 1.5.3 June 2006 N= 593
Teachers	6	11
Students	83	580
Administrators	1	2

Action Phase 2 was characterised by the development of greater collaboration between users of MOODLE. Teachers and students all noted in focus groups that discussions helped in selecting features used within classes and the manner in which courses were presented. Table 5.8 shows the level of increase in the number of student and teacher users. This was due to an increase in the

number of teachers making the decision to access MOODLE and as a consequence student users also increased. During Action Phase 2 it was observed by the researcher that teachers sought out student views concerning the use of MOODLE. This change was noted toward the end of Action Phase 2. This interaction between student and teachers was documented during focus group sessions. These results concerning the interactions and collaboration between teacher and student during this Action Phase informed the decision taken to undertake a wider school implementation. This was due to the shift away from teacher-centered features within MOODLE such as resources and glossary modules, towards a more collaborative approach which identified how students could help choose elements of instruction.

### **5.3.4 Action Phase 3: Whole school implementation**

Action Phase 3 involves the whole school implementation of MOODLE. The results presented in this section are based upon student, teacher and administrator data from

- data logs from MOODLE presenting usage patterns by students and teachers are also presented
- presentation of focus group session data
- reporting on entries made in the researcher's diary and data logs.

The level of use of MOODLE six months after whole school implementation is presented in Table 5.9. It can be seen that the number of teachers accessing MOODLE increased from 45 to 59 users. This change increase the usage for teachers from 43% at the beginning of the phase to 56% near the end. Student access also increased in line with the increased use by teachers. It can be seen from this table that after six months that the following usage patterns for modules and plugins emerged:

- revision quiz usage increased
- glossaries became more widely available within courses
- web links increased to support assessment tasks completion.
- feedback within courses became incorporated
- the use of the *Book* function used to cache web pages increased
- an increased usage of the assignment module as a means of collecting assignments and providing the task sheet
- Meeting Room Booking Service (MRBS) usage increased for staff enabling them to publish morning notices and book rooms and other resources from home – out of hours.

Table 5.9

*Overall Utilization of Resources Available Within MOODLE Action Phase 3*

MOODLE resources	Version 1.7.1 May 2007 Student N= 762 Teacher N= 45	Version 1.8.4 October 2007 Student N= 897 Teacher N = 59
 Assignment	220	320
 Book	21	41
 Glossary	26	39
 Hot Potatoes Quiz	164	204
 Feedback	6	24
 Quiz	167	267
 Forum	151	248
 Resource (Internet links, learning objects, PDF files, MRBS)	2563	4950

Focus group data from students and teachers revealed that the functions used within MOODLE at the commencement of Action Phase 3 were mainly to help students complete assessment tasks. Student's log data demonstrated that students accessed specific web links that contained information only if it related to the specific assessment item. Students' usage data suggested that students did not access extra web sites sourced and provided by teachers. This was determined using the Activity reports feature as described in chapter 4. This allowed the resource presented to be identified by the number of hits and who had accessed the resource.

A common theme identified from focus groups was the increasing confidence reported by teachers and students in using MOODLE modules and plugins. Confidence in the use of MOODLE was noted by both teacher and student groups through the adoption and usage of new functions as they were introduced and the familiarity of use within MOODLE grew. One example was the early instances of teachers using the journal function as part of their courses with students. Focus group results obtained from teacher groups suggest a shift in teacher use towards allowing students to present more detailed responses.

Teachers began to use more collaborative features such as the Journal or Forums to enable stimulus material of different formats, like video, to be presented. Embedding media files within

a journal or Forums gave students more time to re-watch material while having the text area *live* allowing for notes to be made. This allowed students time to reflect and then edit responses. Focus group responses from teachers revealed a change in the detail contained within student responses, and teachers indicated the benefit of this module in developing students' skills in interpreting, expressing and communicating responses.

"Some students' answers are becoming better as this function (journal) allows the student more time to reflect on the stimulus provided. Maybe it is also due to the engagement of the student not using text all the time. I am happy with the change." Year 10 Science teacher (2008)

The following sections details the technical support available during this phase and the change in staff usage through Action Phase 3.

#### **5.3.4.1 Staff technical support available for Action Phase 3**

Teachers interviewed during this research period identified that developing core skills such as adding web pages or creating assignment pages helped develop course materials for students.

To support staff in developing functionality within courses, a range of tutorial areas within MOODLE were established. These courses were developed by the site administrators. These courses were developed for teachers to familiarise themselves with differing functions available within MOODLE. Within these courses teachers were able to analyse the function and decide upon its applicability for students use within their own online course.

Helping to develop teacher familiarity with features was the availability of courses from other sites such as MOODLE.org accessed from the Internet. In this case course content was sourced from external MOODLE sites as backup files for restoration into the school sites MOODLE. These files were then restored as courses within the school LMS allowing teachers' exposure in using a range of differing MOODLE features and content styles for presentations. Such courses were usually augmented with courses utilising embedded online tutorials from MOODLE or Atomic Learning.

The focus group data revealed that IT teachers on staff took this implementation phase as an opportunity to develop help resources within MOODLE and created their own video tutorials using Photo story software for staff at NDSHS. When made available for staff this course log data revealed most teachers accessed these files created (Photo story) from their home. It was noted

from the focus groups that these actions helped to stimulate other teachers to start examining their course designs with a view to improving the functionality available for their students. These instances were observed by the researcher at afternoon professional development sessions and documented in a research diary.

Professional development sessions for teachers were organised as regular fortnightly after school sessions to showcase functions that staff had used successfully with students. During these one hour sessions new module enhancements that help improve core functions were also showcased. An example was the session to demonstrate new features contained within MOODLE version 1.8.4. Staff that attended these sessions identified the value of the instruction they received and outlined areas for further development.

Statistics operating within MOODLE were also presented at these sessions. Statistical features within MOODLE presented teachers with the ability to analyse the usage patterns of their students. Here attempts by students were presented. Data presented included question attempts, successes, and the mean and standard deviations for quizzes. This allowed patterns to be documented and enabled teachers to discuss with students difficulties encountered with content or understanding exam questions. Focus group results from students that concern the teachers' use of students log data support the value of these actions by teachers. Year 11 and 12 students interviewed identified the ability for a teacher to analyse results and re-teach targeted content as particular value for senior students.

#### **5.3.4.2 Teacher MOODLE usage during 2007 - 2008. (Action Phase 3)**

Teacher usage patterns for MOODLE have changed during the period January 2007 to December 2008 as shown in Figure 5.2. Focus group sessions and diary notes provided further evidence for this change in teachers' usage of MOODLE.

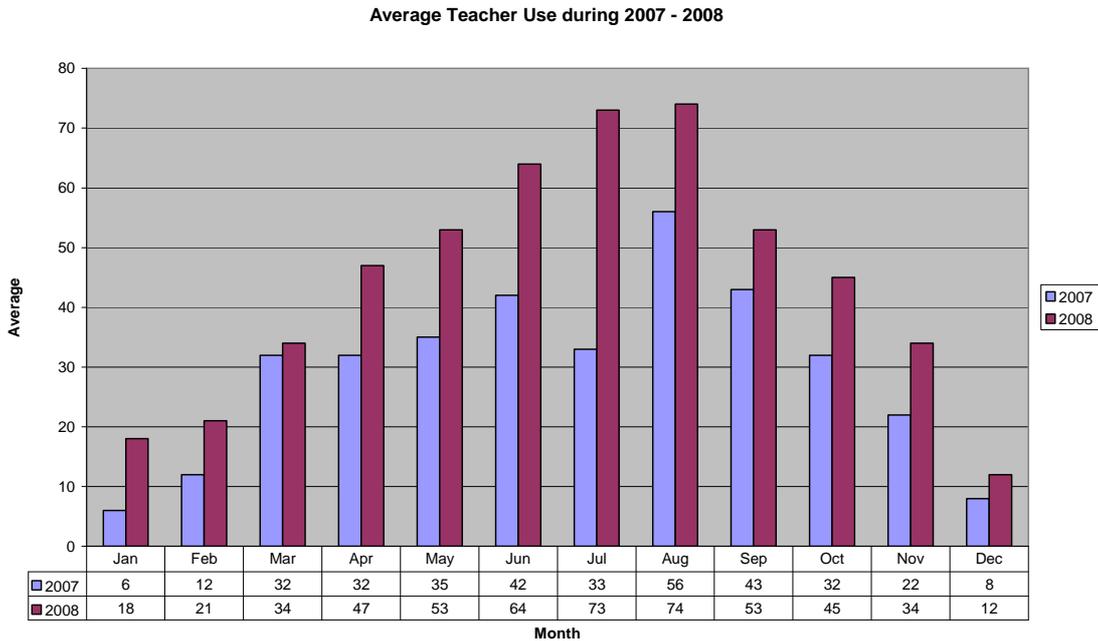


Figure 5.2 Teacher MOODLE usage 2007 – 2008 (N = 93)

Figure 5.2 shows an increased usage of MOODLE by teachers at this site. Teacher usage data indicates an overall increase in usage during Action Phase 3. The uptake in the use of MOODLE by staff during this period may be attributed to the major exams period occurring mid-year. Both 2007 and 2008 results show that teacher usage increased mid-year. Focus groups confirm teachers used MOODLE more frequently during these months particularly in setting up revision activities available for students. Some teachers also used the quiz features to help reduce marking loads within certain subjects, like Science, facilitating exams for students using MOODLE.

### 5.3.5 Technical development of the MOODLE site.

An operational goal of continually upgrading MOODLE as new versions of MOODLE became available was established at the beginning of this trial. Cognisant of any software applications having *bugs*, the decision was taken to upgrade only to the latest stable version of MOODLE using SVN. SVN is a server system which contains the latest stable version of MOODLE including any security/bug fixes or improvements. These are updated daily by the developers as improvements, bug fixes or security fixes are committed to the main program. Typically most versions of MOODLE are never more than seven days out of date. This process was automated on the NDSHS server and was facilitated using code commands (script) within the Linux-based Operating System. Documentation available on the ways to update and control versioning of non-

standard modules is accessed from MOODLE.org. Course and site back ups of the whole site are taken every day for a seven day cycle. This made saving data possible when breakdowns occurred within the school network enabling the latest back up to be installed. Doing so meant only the data for that day was lost. The results of this process were documented within the research diary helping to develop a chronicle of sustainable practice. Table 5.10 shows the developmental Phases for the versions of MOODLE operated.

Table 5.10  
*MOODLE Version Upgrades and Core Functions Available*

MOODLE Version	1.4.5	1.5.3	1.7.1	1.8.4	1.9.2	1.9.2+	1.9.4+
Upgrade occurred	Jan-06	Jun-06	May-07	Oct-07	Jun-08	Sep-08	Jan - 09
	Core functions available						
Book			Y	Y	Y	Y	Y
Assignment	Y	Y	Y	Y	Y	Y	Y
Chat	Y	Y	Y	Y	Y	Y	Y
Choice		Y	Y	Y	Y	Y	Y
Database		Y	Y	Y	Y	Y	Y
Feedback		Y	Y	Y	Y	Y	Y
Forum	Y	Y	Y	Y	Y	Y	Y
Glossary	Y	Y	Y	Y	Y	Y	Y
Hot potatoes quiz		Y	Y	Y	Y	Y	Y
Grade book	Y	Y	Y	Y	Y	Y	Y
Open Uni Grade book						Y	Y
Journal				Y	Y	Y	Y
Questionnaire		Y	Y	Y	Y	Y	Y
Quiz	Y	Y	Y	Y	Y	Y	Y
Scorm				Y	Y	Y	Y
Wiki	Y	Y	Y	Y	Y	Y	Y
OU Wiki						Y	Y

Table 5.10 shows the core functions available within MOODLE for the different versions of MOODLE. Each version of MOODLE is represented by the version number and the month and year it was implemented. This table evidences the continual development releases from Moodle.org and highlights the changes incorporated into MOODLE at this site. This information was used to check the uptake by teachers against their incorporation of new features within an Action Phase. This presents definitive dates for inclusion of core features within MOODLE at this site as the information obtained represents the day that MOODLE was upgraded. This information was used to cross check results obtained from focus groups to address Research

Questions 2 and 3 concerning MOODLE features used and the manner in which they are used within courses.

### **5.3.6 Summary of findings**

Within the Action Phases considered in the foregoing section, participants identified aspects they considered as facilitating changes in teacher practice, and aspects interpreted by participants as necessary in the development of *sustainable practices* at this site. These considerations are summarised below and have been identified as critical in the development of this LMS. The identified aspects detailed below represent common responses from participants.

#### ***Students indicated the following aspects as important in the development of user practices:***

- Involving both teachers and students in design of online courses.
- Showcasing successes and discussing failures.
- Sharing ideas or examples of work with their peers using the communication features identified in section 5.3.4.
- Using networks that help improve the understanding and sharing opportunities between fellow students.

#### ***Teachers noted the following aspects as important in the development of user practices***

- Developing site-based school practices where classroom users have a say in features used within courses.
- Providing professional development based on need. This was an area that teachers identified as allowing them the chance to develop their decision making and understanding processes. This is described in section 5.3.3.
- Involving teachers and students in design of online courses.
- Showcasing successes and discussing failures.
- Governance – decisions concerning LMS features need to be made at the local level.
- Networks used should be both formal and informal. The formal networks that existed within the school occurred through the use of Professional Development sessions described in section 5.3.4. The informal networks relate to the in and out of hours communication between staff using the communication tools.

*Administrators noted the following aspects as important in the development of user practices:*

- Establishment of reliable internal school networks in developing practice and supporting functionality and use of the LMS.
- Internal connectivity should allow high speed supporting functionality unavailable through access to external LMS sites.
- Providing regular updates of versions keep security and functions current.
- Using realistic timeframes for development of courses and user skills.
- Using governance processes to help locate decisions concerning the LMS features use within the classroom context.

The following section discusses foregoing results from these Action Phases and considers the results in relation to the RQs and the development of sustainable school practice.

## **5.4 Markers of sustainability**

### **5.4.1 Introduction**

The results obtained from this research are considered in the following sections using the 5 markers of sustainability identified in chapter 2- Literature Review. In the following sections the results and observations for the implementation of MOODLE are examined using the derived markers of sustainability as described in chapter 2, namely:

- Networks
- Adaptations
- Scalability
- Governance
- Site Activity

The results below have been presented as either the summarised data and/or reflective quotes from participants in the different participant groups. The summary comments obtained from the focus groups have been presented in the tables below and listed according to the groups of participants to which they belonged.

### **5.4.2 Networks**

Table 5.11 provides summary comments on networks as a theoretical marker for sustainability from focus group sessions. These are categorised using the research groups. The aspects detailed in Table 5.11 stem from literature (Ripamonti et al., 2005; Hennessy & Deaney, 2004; Merkel et al., 2005) as considered in chapter 2 regarding the importance of developing site-based networks

supported either by formal school development structures, such as PD sessions, or networks that are informal occurring in an ad hoc manner based upon need.

Table 5.11  
*Networks – Focus Group Data (representative comments)*

<b>Grouping</b>	<b>Focus group comments</b>
<b>Students</b>	<ul style="list-style-type: none"> <li>• Some teachers show us how to do things which is good.</li> <li>• MOODLE is easier than Face book to use so I help others. (22%)</li> <li>• Most of us look for cool things to put in courses.</li> <li>• I use the messaging function to get help from home. (58%)</li> </ul>
<b>Teachers</b>	<ul style="list-style-type: none"> <li>• I think that staff must be interested in being involved. You need one key <i>knowledgeable</i> person within the school who is enthused about something that they thought of value for both students and staff.</li> <li>• You also need a competent IT person to support its implementation and ongoing hassles. 85% of teachers identified this aspect.</li> <li>• Students help keep me up to date. I can't possibly know all the stuff on the web.</li> </ul>
<b>MOODLE Administrators</b>	<ul style="list-style-type: none"> <li>• Targeting and instructing one member of each staffroom has eased the level of access to help from us. The mentoring process (outlined Chapter 4) has allowed a lot more experimentation of <i>new</i> functions that can then be demonstrated for others.</li> </ul>

*Students*

The focus group comments in Table 5.11 are representative of student views concerning this sustainability marker. Responses indicate that students are contacting each other from home out of school hours. There is also evidence of students spending time sourcing resources for their courses. In addition, students reported that they find the messaging system easy to use and it helps with the completion of assessment. The research diary notes and focus groups with students revealed that students informally developed their own networks.

“I contact people in my class for help. There are a few of us who talk in class but I always leave messages for Fergus and he gets *links* to me. He’s good even though we aren’t mates at school.”(Year 9 student)

“We do a lot of sharing away from the class. We are too busy copying notes so our messaging and blog sharing helps me complete work” (Year 8 student)

The data also indicated that the interaction between students occurred in an unstructured manner and seemed to be based around a common need. It was noted during the research that students would often share information regarding assignment completion or respond to requests from other students for help to answer questions on revision tests. The networks used seemed to last only as long as they shared a course together.

### *Teachers*

Focus group responses obtained from staff groups as indicated in Table 5.11, identify the need for a site-based *champion* to act as a sort of pioneer in developing the initial courses. Interview data suggests that staffs are more likely to identify with successful practice stemming from a colleague. Research diary notes support this aspect with comments identifying the notion of credibility and relevance as important as other teachers can see the usage and discuss the potential of change for their classes. Clark and Dickson (2003) note the importance in their study about the development of local priorities for ICT use and the localised support systems needed to maintain it as pivotal for success in its establishment. These assertions are supported through similar studies (Ripamonti et al., 2005; Hennessy & Deaney, 2004; Merkel et al., 2005) and agree there needs to be a focus on the actions of the participants and what underpins the decisions to use technology within the school context.

### *Administrators*

The administrators noted that the targeted development of staff members seems to have been successful. Table 5.11 reflects this sentiment with responses indicating that having a staff member on hand helps in the development of others within the staffroom. This strategy has been identified as helping to develop a network of users across the school. Further focus group responses from staffs, indicates that having a trained staff member within a staffroom helps create an environment more conducive to experimentation and discussion of features related to the discrete curriculum area. An example is found from the Maths staffs that identify a particular MOODLE plug-in Dragmath, as of benefit in helping to enhance online exams and resources. Staff noted they felt more comfortable in experimenting when they could access a peer to trial the use of Dragmath. Dragmath is a java applet that allows for the creation of scientific notation. This can be used within any text box within MOODLE.

### 5.4.3 Adaptations

Table 5.12 provides the summarised data and comments from each of the focus groups and research diary relating to the theme of adaptations. The focus group conducted explored how users incorporated course functions within their practice. Table 5.12 outlines responses describing changes for users in how they store data and communicated with their peers. Data obtained from diary notes, MOODLE log data and focus group responses indicate that users assessed features that help maintain data and enable a sharing of data. An example is the use of the blog feature by students for storing notes taken from class or from websites for later use in assignments. The information was shared between them by making the settings either private or personal for their individual blog. Communication on times when this “file” was available was facilitated using the messaging system within MOODLE. For teachers wishing to avoid plagiarism data logs helped track student access to resources

Table 5.12

*Adaptations – Focus Group Data*

Grouping	Focus group comments
Students	It's good I don't have to remember my memory stick or books. If I need to, I can log in and get my stuff. (43%) I can share resources with my friends either with blog or the messaging system. Using the blog features helps me keep good resources I can use later.
Teachers	Stops having to access differing drives within the school network and allows me to get my resources from home. I can check usage from logs or see individual student blog or notes pages to see if they have done any work.
MOODLE Administrators	Makes the system tidy. Reduces the reliance upon teacher's memory of where they put stuff and then coming to us for help when they can't find the item.

#### *Students*

The results from the site log data confirm the expansion of the materials held within the LMS. Student data logs indicate the use of blog pages being used by students keeping relevant assignment and course materials. The blog pages enabled student to keep notes and files within a secure space that was protected by permission rights assigned to the student. The focus group data and diary notes provide evidence that some students have used this area as a collaborative space for group members to access their pages. This feature demonstrated a change in use by some users moving from class note books to online storage of notes. Students confirmed that the use of blogs as a useful feature for storing pictures, video or other digital data quickly and retrieve this at

any time. Focus group data responses (43%) confirmed that students find this an easy method for maintaining and storing data.

#### *Teachers*

Helping maintain all resources in a central place (MOODLE) with access to courses from within and external to the school was identified in focus group sessions and recorded in diary notes, as highly beneficial and helped promote usage of MOODLE. Furthermore teachers indicated that accessing resources as important as it allowed students and teachers access to school resources anytime and affording the ability to utilize differing data formats.

Teacher focus group responses also highlight the satisfaction of MOODLE users in accessing resources. Teacher responses indicated an initial level of frustration at the navigation paths and folder system that exist within the MOE school networks. Some teachers maintained their own courses (hidden from student view) and much like a filing cabinet have deposited resources within this one area. Data obtained indicated that having teaching resources available in this format enables access from anywhere and teaching partners can be added to the course to share resources.

#### *Administrators*

Responses from administrators indicated that over time teachers changed their approach to the way data was stored. Data logs identify some teachers building or maintaining personal spaces (blogs) for the storage of resources. Some teachers were noted to create courses for themselves or as a faculty and use these areas for discussion of faculty operation. Administrators identified this as an important developmental step in teacher use as they now could access resources or develop digital resources outside of the school environment. This was confirmed within Research Diary notes as being “free of having to remember memory sticks or files "allowing work tasks if needed to be completed externally from the school.

### **5.4.4 Scalability**

Scalability within this research context was defined as the ability to create and maintain resources while allowing new versions and module enhancements to occur. Details of the growth of resources and functions available within MOODLE are presented in Table 5.13. Scalability was considered as an important aspect by teachers and administrators helping to encourage learners to bring in and link to their own existing online content. BECTA (2007) identified a similar trait

stating, “Personal blogs, wiki’s and content on social networking sites, for example are more likely to engage them in online-supported learning in schools, colleges or universities than if we continue to insist on a rigid separation between institutional life and the outside world” (p. 3).

Table 5.13

*Summary Resource Growths (Number of instances of uses within MOODLE) January 2007 – December 2008*

	Version 1.7.1	Version 1.8.4	Version 1.9.2	Version 1.9.2+
Year / month	May 2007	October 2007	June 2008	December 2008
Assignment(s)	220	320	422	492
Book (cached pages of text)	21	31	42	51
Glossary	26	39	44	48
Hot potatoes quiz	164	204	235	298
Journal	0	3	16	43
Quiz	167	267	293	356
Resource (Internet links, learning objects, classroom resources)	2563	4950	5641	6210

Results presented in Table 5.13 demonstrate usage growth during Action Phase 3. Within this table the top of the columns show the regular version updates to the MOODLE database. Some of these upgrades feature new modules or plugins that have been incorporated into core applications of MOODLE.

Table 5.14 provides a summary of comments taken from focus group sessions concerning scalability.

Table 5.14

Scalability – Focus Group Data

Grouping	Focus group comments
Students	Scalability means something keeps going right. I know that our course in year 11 keeps changing and the quizzes get more difficult as we get into it (the subject). The latest version has better features than the last. It's not as clunky as when I was in grade 9. The messaging helps me get the stuff I missed from friends during class. The grade books are good. Mum likes to keep a check on mine.
Teachers	Away from the traditional school setting, I think that online communities need to offer something to the target audience in an easy to find format – members will not persevere if the navigation of the online community is difficult. The loading of assessment task sheets onto MOODLE and resources specifically tailored to help with assessment are quite popular too. In my experience, students appreciate the personal touches. Some students check for new items added. That is a satisfying feature of the logs. It is nice to be <i>in control</i> of using or not using features within MOODLE. I don't feel pressured to constantly change. I make the decision.
MOODLE Administrators	MOODLE has changed enormously from version 1.4.5. Courses too, have become more sophisticated. Some teachers have made their course too cluttered. Having real data is great for using as justification for the school admin. The CVS feed is a great feature helping to keep the site updated.

### Students

Students indicated that the MOODLE course design promoted familiarity, providing a consistent structure for application features useful in completing tasks. Some students indicated they enjoyed having access to a range of courses as they were able to learn functions like Hot Potato quizzes that helped them learn content. Data from Table 5.13 shows the use of the two quiz features within MOODLE used extensively by students for revision. The messaging system too featured in the discussions and highlights the ability to share information and ideas easily between students out of school hours. The students liked the fact this occurred without the need to change screens.

Students indicated that they liked the way new features appeared, noting that the changes kept the applications fresh. Focus group responses from year 11 and 12 students noted the acceptance and acknowledgement of the value of the quiz module offering a structured environment for revision.

This was a consistent feature that was noted in the research diary and through course data logs demonstrating the growth of this feature.

### *Teachers*

The focus group data revealed that teachers made the choice to incorporate and use a new feature. One example is the *Journal* feature (Table 5.13). This module was installed during the upgrade to MOODLE version 1.7.1. A Journal enables a user to view digital content and then reflect upon what they have observed. The responses are stored digitally and teachers can comment upon and grade the responses if desired.

Teacher focus groups explored the different features. They commented on how useful they found certain functions. Responses revealed teachers felt quiz features were useful for students helping with revision. Table 5.13 shows the level of use which was significant. Further, teachers also identified the use of more recent features like Journal helped to develop a student's ability to reflect upon digital stimulus material.

Also staffs within the focus groups were asked about the platform itself and how a consistent approach through versions helped maintain usability. Staff involved in the initial course building using early versions did notice a difference in functionality and an improvement in the features available. Teacher users identified the consistent look of MOODLE helped in developing confidence. Some staff indicated strongly that they were happy using just core functions "to get the information out" and other staff indicated they looked forward to new features especially those that could be commented upon, marked and then printed for student folios. One such feature was the Journal function. Also functions that helped save time for a teacher in collating student grades or profiles were identified as beneficial in maintaining teacher usage. This was reiterated in comments about the quiz functions and grade book applications for similar reasons.

### *Administrators*

Responses from this group presented in Table 5.14 indicated the benefit of the automation in the technical upgrades of MOODLE. This feature was deemed by administrators to help deliver new or improved modules. In addition it automatically e-mails site administrators of the changes made. This feature through enabling an e-mail could then be distributed to teachers documenting the changes and the purpose of the new features. The inclusion of new features within MOODLE

helped develop topics for some professional development sessions or often encouraged teachers to examine and trail the newly incorporated feature.

Responses (Table 5.13) also indicated within course development that some teachers made many links to resources while others kept links to a minimum and focussed upon the student resources being available to complete an assessment item. The difference in the approach to course development was noted in the course log data, and this identified the main access was to resources that aided students in course completion not reading links.

### 5.4.5 Governance

Within the research context governance is the ability to select what features are used and the ability to decide how features are used within MOODLE courses. Governance (Ballantyne, 2004) in this context was found to be important to each participant as a way to develop and maintain *control* of their online classroom. Table 5.15 provides the summarised comments and data derived from each of the focus groups relating to the theme of governance.

Table 5.15  
*Governance – Focus Group Data*

Grouping	Focus group comments
Students	Students value their ability to access/create a <i>personalised</i> online blog space In some classes we get a say in the resources we want. (58%) Its good to get the feedback from quizzes quickly and access grade book information (59%)
Teachers	The loading of assessment task sheets onto MOODLE and resources specifically tailored to help with assessment are quite popular too. In my experience, students appreciate the personal touches. I know I am an EQ employee but I work for NDSHS. I like the idea of dealing face to face for help and not relying upon a helpdesk. (23%) Help is always at hand within the staffroom or at the server room.
MOODLE Administrators	Teachers like the idea of being able to trial new modules or plugins and talk within their staffroom about the application of these elements for their students. It is good to see teachers participating in wider forums for ideas for classroom practice. Accessing Open University courses and modifying these has helped raise the standard of course design and encourage new ideas.

#### *Students*

Focus group responses from students as represented in Table 5.15 reveal the ability to access their results and teachers feedback and share these with their parents (59%) as an important consideration in using the LMS. Students identified this as important as it provided a real ability

to demonstrate current results. They were able to show they had completed tasks or accessed resources. Students also identified the ability to create their own blog space contained within their profile as being important for them in creating an online presence.

#### *Teachers*

Some teachers interviewed articulated a sense of pride that they were helping each other and supporting other schools sites using MOODLE. Within Table 5.15 a few teachers indicated responses that identified the informal nature of developing courses as beneficial and credited the school's administration with being supportive of this framework. One teacher commented he was "more likely to do it willingly than be expected to do it".

Teachers also commented that liked the ability to control their own course features. This comment "I know I am an EQ employee but I work for NDSHS," contained within Table 5.1 alludes to the notion of ownership identified in chapter 3 and helps provide evidence of the development of the community.

#### *Administrators*

Table 5.15 identifies the administrators' responses contained within the research diary. They noted they were enthused to see teachers participating outside of school networks sourcing information from wider ICT community discussions. This aspect was identified as of benefit as there was an increased likelihood of sourcing new ideas helping to develop the site. Here staff development course logs identified staff as accessing sites with pre-packaged content for inclusion into NDSHS courses.

#### **5.4.6 Site activity over time**

Results from the focus groups, research diary and data logs provide evidence of growth in the level of activity and the uses of MOODLE over the research period. The results presented in the foregoing sections provide evidence of a developing community. The markers of sustainability help identify evidence of the key aspects that contributed to the site activity within this site and the potential of sustainability. Table 5.16 presents data concerning the importance of site activity and the contribution by MOODLE users in the development of sustainable practices.

Table 5.16

*Site Activity – Focus Group Data*

Grouping	Focus group comments
Students	Having the resources in one place is good as I feel it saves time. I spend my time on the revision quizzes as I know that they come from our class notes. Makes research easier having core web pages available.
Teachers	A lot more of my preparation time has been taken up searching for resources etc to add into MOODLE courses. I tend to now add relevant resources onto MOODLE, so I can show students during my lessons – much easier than trying to remember website addresses etc. This also shows students that I value the incorporation of MOODLE into their learning. The more users the more people I can access to help my practice.
MOODLE Administrators	Updating versions takes little time and security logs are my morning reading. Modules and plugins can be time consuming but the time goes into ensuring they operate under the EQ systems. Decrease in time taken showing teachers how to use elements of MOODLE has frequency in use improved.

*Students*

Results presented in Table 5.16 acknowledge students perceived saving time locating initial resources needed to complete assignments. Students also identified as important having *scaffold* material available for essays in a digital format provided an easier start for some on their writing tasks. These took the example of *sample* structures or online format providing an area to sequence resources identified. Students also noted that the external access to MOODLE files was slower especially downloading video segments. Other students took home these files on memory sticks.

*Teachers*

Results presented in Table 5.16 note that teachers initially spent time learning how specific functions operated. Teachers also noted the benefit of having someone on site to help show them how to use a specific function of module. The teachers’ demonstration course area within MOODLE was identified as a positive. This is supported by specific log data (Table 5.13) evidencing resource growth within the site. Here different functions and their numerical presence within MOODLE helped demonstrate how teachers have incorporated features into courses offered to students. Scalability also is evidenced by non-standard quiz applications being incorporated into MOODLE. The use of hot potatoes a non-standard MOODLE quiz feature provides evidence of teachers sourcing and using alternate formats to engage students. Course data logs and research diary notes as mentioned confirm the students accessing these features. Also noted within Table 5.13 is the incorporation and usage of more reflective module Journal.

This feature has been incorporated within senior courses helping provide students with a space to document decisions and concerns regarding resources used for assignments.

### *Administrators*

Administrators noted the increases in site usage as presented in Table 5.16. Administrators also outlined how their time spent showing teachers the functions has decreased. One administrator described a “decrease in time taken showing teachers how to use elements of MOODLE as frequency in use improved”.

Logs of site activity provide evidence of the developing community. With more individuals developing skills and confidence there seems to be an increase in self reliance and a decrease in the reliance upon a few experts. Research into site based ICT communities (Wellman, 2001; Castells, 2001; Rheingold, 2002; Hennessy, 2004) found a community develops over time as users come to rely on each other for ICT solutions to problems particularly as the site grows in complexity and sophistication. Participants seek and develop greater skills drawing from the energy and growth of others within the community. Sévigny and Prévost (2005, p. 4) in describing a learning community suggest the conditions of “trust, reciprocity and teamwork” help a community develop and grow.

## **5.5 Conclusion**

This chapter has presented the results of the research carried out to investigate the issues impacting on the implementation and operation of MOODLE as a site-based LMS. The chapter also examines the results in terms of the sustainability markers for sustainable use of MOODLE. The data presented identifies a number of aspects that may benefit the development of a site-based ICT community in a large high school as described in chapter 3. Indications gained from focus group interviews and supported by usage statistics, demonstrate that ICT practices of teachers and students do change given conditions that enable each individual’s skill development. This development however needs the support of structures that further enable and allow the development of networks within the community. The evidence has shown that staff and students involved in this research reported varying experiences in the use of the LMS. The varying experiences perceived by staff and students concerning how and what features they use, and the development of where they incorporate ICT into practice highlights the significance of the changes that have occurred for both individuals and the wider school site. These changes indicate that an individual site incorporating an LMS within school practice shows possible improvements for work practices. These aspects are further considered in chapter 6.

# Chapter 6 - Conclusions and Recommendations

## 6.1 Introduction

This dissertation has concerned itself with an examination of the implementation and deployment of MOODLE, at Noosa District State High School. The background presented in chapter 2 and findings presented in chapter 5 have identified a range of issues that can influence a sustainable implementation of MOODLE within a school. This chapter presents the research findings with particular reference to the research questions and outlines the implications of the findings outlined in chapter 5. Then research findings, in combination with the literature review and technical considerations are used to develop a set of guidelines for a sustainable implementation of a LMS at a school. This chapter concludes with suggestions for further research and summary remarks.

## 6.2 Research findings

This section initially, presents the findings addressing the research questions that frame this study. The conclusions from the findings described in chapter 5 are then presented. Each research question presented in chapter 1 is considered separately by drawing together the findings from the literature in chapter 2 together with the analysis undertaken in chapter 5.

### 6.2.1 Finding for Research Question 1

The major aim of this research has been to explore aspects of sustainability as it applies to the use of MOODLE within this school site. This aim has been addressed using three research questions. The following presents findings that provided the answers to the research questions.

#### ***RQ 1. What are the critical considerations for implementing a sustainable LMS in a school community?***

The results presented in chapter 5 have emerged from the perceptions of the three primary stakeholders: students, teachers and administrators. The perceptions of these three groups of stakeholders are considered in turn and then considered collectively.

### **Students' results**

Chapter 5 results indicate students were quick to incorporate technology into their learning framework. This is evidenced through a number of common features identified by students in using the system. These main aspects identified by the students in their use of MOODLE were the convenience of access to resources. Speed was also found to be important with students noting a faster delivery of digital content using the school intranet. The social element to MOODLE was also identified allowing for collaboration was identified as beneficial in completing work.

Log data for student usage indicated that many users of MOODLE accessed external data to enhance their assignment completion and other activities. This tended to occur after accessing the initial resources and assessment outlines contained within a course. Furthermore, course log data demonstrated use of assessment *help* resources and exemplar assignments examples provided within courses aided in the presentation and structure of their own work. Students consistently identified the access to exemplar assessment items and support material as highly beneficial in completing tasks set by teachers. This result was confirmed from focus group session data obtained from both students and teachers. Students also reported these *sample* assessment items and support material being available as a resource to allow their parents to see what students were working on. Blogs spaces were also identified by students as useful tools for assessment completion as these can be private or opened to peers for collaboration.

The following aspects were identified by students as “critical considerations” for them in using MOODLE as part of their learning:

- speed of resource availability provided by the internal network (loading)
- ability to participate in course design and structure
- messaging to establish networks between users
- use of collaborative functions such as blogs, wiki's, journals to identify student interactions helping to complete set tasks.
- using self-marking exams with video content. These were considered important by students as they could watch videos a number of times helping them retain the information for the course.

### **Teachers**

Results from chapter 5 demonstrated a number of areas that teachers considered important in the use of MOODLE. Early e-learning course development by teachers established courses more as

an electronic book that mirrored what was available as hard copy resources within the traditional classroom. This was due in part to teachers not having the confidence to take risks with functions that they were unfamiliar to them. The research literature (Hennessy & Deaney, 2007) suggests this development in teacher confidence using ICT takes time and occurs at differing pace for individual teachers. In this research it was found that this issue was overcome for a number of teachers, through the provision of regular, voluntary, PD sessions where practice was shared as described in chapter 2.

Development of a strategy with a focus upon a number of teachers across the school targeting developing networks was found to be desirable. A similar result was reported by Ripamonti et al. (2005) who found that these networks help underpin professional practice for the use of ICTs. In this research teachers were supportive of this strategy, identifying this process as successful as they were able to learn from their colleagues at the school. Results described in section 5.3.4 revealed this was an important aspect, as discussions between teachers and administrators often included the mistakes made. Mistakes made helped to highlight the importance of regularly using ICT skills and further helped to inform PD session topics. It was found teachers over time also felt comfortable with being able to approach administrators to correct their mistakes. The voluntary nature and ease of access to support based on research undertaken by the administrators and this researcher can be deemed a key success component of the site-based model.

Furthermore allowing students a say in the design of the course and the modules used within a course helped develop the sense of ownership as similarly reported by Ballantyne (2005). This was deemed important by teachers as ownership helped to stimulate usage and this was reflected in both teacher and student log data.

Statistics from within courses demonstrated a number of teachers (Science, SOSE and English) used data to monitor trends in resource usage. This helped to identify resources that students found beneficial in completing tasks as well as resources not being used. Such data was useful for teachers and administrators in comparing resource usage by students from differing courses across faculties. Heads of Departments, as managers, regularly examined course statistics from their faculties and could use this information to stimulate discussions within the faculty with staff about online content, its development and the learning resources provided for students.

Chapter 3 identified literature pertinent for this research helping to develop the following aspects relevant for this research that contribute to sustainable ICT practices at this site. Teachers found the following aspects helpful to support LMS development;

- Flexible usage: Teachers found the flexible nature of MOODLE pivotal in maintaining interest and stimulating discussion with student in their classes.
- School ownership: Having teachers responsible for course design and seeking input from students was deemed important in developing the culture of ICT use.
- Senior management support through developing supportive structures that enabled teachers in the development of ICT practices. One example highlighted was the support given through the appointment of a teacher aide.
- Accessing exemplar courses to stimulate ideas about what can be used within online courses, e.g. Open University courses available to install and modify into the school site.
- Having the LMS operate internally improved speed and this in turn helped develop confidence for users.
- Development of applications that helped improve workflows; such as grade books and self-marking exams.
- Regular PD sessions where teachers could trial modules and plugins, or use and share resources.
- Regular group meetings of teachers and admin staff to showcase development.

### **Administrators**

As described in chapter 2, MOODLE administrators are teachers who within the LMS are given extra editing permissions allowing control in selecting MOODLE functions that can be included within course design and editing choices. The administration group differed from the teacher group as *admins* had the responsibility for site management, often led development sessions for teachers, and sourced and trialed new modules and plugins. Their permission level allows them to make theme changes, module changes and access to functions that control the site. Results from chapter 5 demonstrated a number of areas that administrators felt important regarding successful MOODLE use.

From an administrative perspective early e-learning course development started out more as an electronic book similarly described by teachers in section 6.2.2. Administrators' focus groups responses revealed as confidence within the teacher group grew there was a change in the type of resources that teachers started to incorporate in their courses. These collaborative resources

evidenced in Table 5.4 grew in number suggesting these resources were found useful by both students and teachers. Comparing responses from student focus group data confirmed that discussions between teachers and students did occur and the focus of these discussions centered on what resources were provided. Teachers within the Action Phases reported that they regularly sought feedback regarding both course features used and the level of satisfaction with course material provided. It was also noted from focus group sessions that the most successful courses included material sourced or developed by students.

Administrators at NDSHS found early courses included a number of video segments within courses. Focus group data from students identified large video files created difficulty for students' access from home. This was noted also in student responses that the expectation of downloading video material at home was an imposition of both time and for some users that had limits on their Internet services an extra home cost. Students outlined their concerns surrounding the "waste of time" in downloading these large files. Students also identified they were not likely to access courses that relied upon video material. Feedback given to teachers from students highlighted this aspect and this feedback helped teachers redesign courses. The redesigned courses focused on students using modules designed to help them communicate with each other allowing each other to build or share knowledge.

Teachers indicated the incorporation of student-centered tools contained within MOODLE helped increase course usage and for some students re-engage in their learning. This change resulted in teachers beginning to use MOODLE.org to source plugins or modules in their classrooms.

Within this study a surprising finding was the *value* students placed upon having a say in the design and ICT features used within the LMS. Similar results are reported by Harris (2010) noting the importance of collaboration as a means to engage students. Within this research parallels can be drawn (Ballantyne, 2003) with those of Harris (2010), Brewster & Bowen (2004) seeking to develop *ownership* by adopting a student centered approach to learning. Similarly the notion of *governance* again is reported by these researchers involving students having greater involvement within their learning. This research context identified similar trends through the use of ICT affording students a greater level of autonomy in the classroom context.

The results from chapter 5 suggest that these collaborative actions helped develop the functionality of MOODLE at this site in turn helping to improve the range of MOODLE features available.

As described in chapter 2, MOODLE operating as an intranet enabled the artificial limitation imposed through bandwidth to be negated for onsite access. When the LMS operates during the day there are no file size restrictions for courses. Students can access and utilize large media files to create or review peer work in multiple formats that would not be easily accessed from home via the Internet. The use of the intranet enabled Film and Television students to develop media content to showcase work for students from other year levels. A result of this action was to help stimulate discussion and enhance the promotion of school events. Classes were able to utilise files of any type and submit these to their teachers. Data logs (Action Phase 3) began to reflect a change in student usage patterns identifying access by students to these resources. Students were also noted to begin sharing files with peers to gain feedback from each other before submitting drafts assessment items. Teachers were noted to use data logs to identify the possibility of plagiarism from other students.

During Action Phase 3 teachers began to identify software applications for use by students using the MOODLE web portal. Industrial Technology teachers sourced an open source software package called *Pro-Engineering* to allow Graphics students to develop sketches and seek comment from their peers on designs. This file sharing was possible through using the blog spaces feature contained within MOODLE.

MOODLE administrators during this phase noted that a number of elements were considered as crucial in developing sustainable practice for both teachers and students using MOODLE. Formal and informal networks were noted to be developing. Log data obtained indicates that students often came together to share ideas or complete a task and then stop the contact with the individual after the completion of the activity.

The elements considered by administrators as crucial in supporting sustainable practice are:

- Flexibility: Administrators found the adaptability and scalability of MOODLE pivotal in maintaining interest and this helped in stimulating discussion and action around the changes and growth within this site.

- Internal network speed and reliability: This was identified as important by users in the development of user confidence. The Internet was identified as not as reliable as the intranet used for the school-based delivery investigated in this research.
- Adaptations: Adaptations are the opportunities to be able to identify and trial applications that help improve workflows. Administrators noted the changes in site practices by *users* concerning adaptability.
- Scalability: Scalability within this context was having the ability to adapt and incorporate new features or course material either from within or external to the school site. This helped to develop new content and methods for designing courses.
- Site Activity: This element was determined as essential and occurred through sustained usage at critical times of the school terms, but also through incorporation of student-centered approaches like the fortnightly television news that engaged students. Such activities helped stimulate use and further stimulate ideas for other applications.

### **6.2.2 Findings for Research Question 2**

#### ***RQ 2. What are the critical developmental and operational parameters needed in the establishment of a sustainable site-based LMS?***

Chapter 5 findings have demonstrated both developmental and operational parameters to enable sustainable use of MOODLE from a school community perspective as shown by student, teacher and administrator data. The discussion that follows is presented using the sustainability markers identified and these markers are used as discussion headings concerning the developmental and operational perspective in using MOODLE. This structure allows for the results obtained to be discussed within the context they occurred in through the development of MOODLE as the LMS at this site.

#### **Students**

The critical developmental and operational parameters for MOODLE considered by students are as follows:

- Having up to date material available in course.
- Being able to use self-marking resources.
- Having access to interactive functions – chat, forums. Using applications that can be used on other devices. For example MOODLE access on their mobile phone.
- Having a say in course material used within courses.

**Developmental perspective:**

Focus group responses from students presented in Table 5.12 highlight the need for resources that are *engaging*. This aspect was discussed within student focus groups and revealed engaging also could mean collaborative. Usage data also suggests that students, when using MOODLE course material, were more frequently inclined to access interactive sites or the collaborative features within MOODLE.

As detailed in section 5.3.3, students also wanted to have a say in the selection of course material. This suggested that for some students a greater say in course material and the features offered was important. Students further identified that regular up to date review material, in the form of revision quizzes, available from home was essential to stimulate student use.

A small group of students, as described in chapter 2, accessed the school technician and trialed modules and plugins helping to inform administrators of some of the functions' use and potential benefit for classes. One example that this group of students identified was the MOODLE mobile phone plugins. Student data revealed that within this group, some students identified that they felt comfortable in undertaking their own web searches to identify compatible plugins for MOODLE. These students often challenged their teachers to learn and incorporate *new* MOODLE functions. Some students who frequently used MOODLE, as described in chapter 5 were active in helping some teachers to learn functions that benefited students.

**Operational perspective:**

Course data logs obtained from sample courses highlights a number of features students found useful for learning. Focus group session data presented in Table 5.13, outlined responses from students questioned about core MOODLE resources. The students confirmed that embedded websites, journal functions and media functions helped to make revision away from school more engaging. Also online self-marking resources that provide immediate feedback to a user were identified as important in maintaining student interest. Furthermore teachers' interview responses confirmed these features as having an effect upon course usage by students. In this respect teachers that sought input from students about course functions were more likely to have students using their course.

## Teachers

### Developmental perspective:

Teacher data presented in chapter 5 indicates that some teachers were making the transition from a *novice* user of technology toward a *critical* user who enjoyed sourcing and experimenting with open source modules and plugins. This approach helped extend not only the functionality contained within their courses but further enhanced the range of features available aside from the core features of MOODLE. This change in teacher practice from user to a consumer of ICT enhanced the range of features available across the MOODLE site. The approach also supported students and their teachers discussing their learning environment helping empower both user groups.

In summary, critical developmental and operational parameters as identified by teachers were:

- Access to teacher aide support: This was identified as important for both the novice MOODLE users through to the teacher aide checking features within courses were working for more experienced users.
- No expectation or timelines for development. This allowed teachers time to make the decision to use MOODLE or observe development prior to making their decision.
- Advocacy of peer developed professional development. Teachers learning from their peers and sharing practice within their context.
- Access to software and personnel to demonstrate its use.

Teachers data presented in section 5.3.5 identified a range of issues considered important for developing a site-based LMS. Central was to minimize the time taken to learn new ICT skills needed in using functions within the LMS. With other school administrative tasks competing for time, teachers supported the allocation of a resource person they could access when necessary as absolutely vital in supporting development. This is similar with studies undertaken by BECTA (2008). Further teachers identified *accessibility* as important if they had not used LMS functions for a period of time; they could access this person to be reminded of specific skills. Data presented in chapter 5 evidenced teachers accessing this person as a resource. This access to support is identified by Ripamonti et al. (2005) as an integral component to developing and sustaining networks.

As noted in chapter 2, MOODLE was implemented over a series of Action Phases. This planned implementation of MOODLE was important for teaching staff as it provided a means for them to

examine how colleagues used MOODLE with their students. In addition students were consulted in the development of courses. Topics discussed with students included modules and resources students perceived beneficial for their classes. Teachers identified students as a valuable resource for them to help learn how to use some elements of MOODLE. Log data trends suggest that usage was higher if students had input into course design and functionality. This finding supports the results of research concerning the use of learning communities (Sévigny & Prévost, 2005) highlighting the benefit of participation in decision making, for all users in the use of an LMS.

In this respect research undertaken by BECTA (2009a) outlines a range of approaches to supporting teacher development of skills using LMS. They suggest that professional development (PD) should align with need rather than system timelines. This suggests a strategy of offering PD, when needed, enables user-centered decisions in the development of MOODLE. This supports the notion of community described by a number of researchers (Merkel et al., 2005; Ballantyne, 2003; Sévigny & Prévost, 2005). Staff data from chapter 5 notes not having the implementation of MOODLE tied to school systemic EQ Professional Development cycles as important in teachers developing the uses for MOODLE. One reason offered is that teachers were more in charge of their professional decisions which a number viewed as important.

### **Administrators**

The critical developmental and operational parameters as identified by administrators are as follows:

- The need for a staged approach to cite development and use.
- The need to have a support position for teaching staff that is readily accessible, e.g. teacher aide time for support

### **Developmental perspective:**

Part of the research design was to facilitate a model where teachers made a voluntary decision to use MOODLE. The model used to transition teachers from a classroom setting to using an online environment is represented by the staged approach described in chapter 2 and chapter 4. This approach is consistent with strategies described by Sévigny and Prévost (2005) for the development of site-based ICT skills. Ownership as described by Ballantyne, (2003) is an integral component in the development of a culture that supports structures that enable collaboration (BECTA, 2006; OECD, 2007).

Chapter 5 findings reveal that the implementation strategy of targeting one person per faculty was successful in establishing a resource person able to demonstrate MOODLE functions and help willing staff within all faculties. Locating a staff member within each faculty helped develop teacher confidence within staffrooms. This enabled teachers to access the knowledge needed to discuss and trial differing applications within their individual curriculum areas. Fundamental in establishing teacher confidence was the administrators sourcing exemplar courses from other sites like the Open University. This strategy allowed teachers within this site at NDSHS to examine course structures and be exposed to differing modules and plugins they may not have considered as part of their own course. Using exemplar courses and modifying these for use within the NDSHS MOODLE promoted a high standard for course design.

Professional development strategies described in chapter 2 focussed on the development of sustainable aspects helping to increase teacher and student use of MOODLE. Administrators promoted the collaborative and administrative features of MOODLE as a strategy to target changing the mindsets of the teacher group. As reported in chapter 5, administrative features helped change the way teachers used ICT. Noted in chapter 5 was the use of courses for *professional* use with some teachers designing courses to allow them access to their resources away from school. This feature enabled full access to live resources and negated the need to install files again when at school.

Further, administrators identified the use of MOODLE features like “grade books” as helping reduce the time spent by teachers on administrative tasks. The changes were an aspect that focus groups revealed as a positive of using a LMS portal.

### **6.2.3 Finding for Research Question 3**

#### **RQ 3. *What features of an LMS contribute to sustainable use?***

Staff interview data in chapter 5 identified a number of aspects that can promote and enhance sustainable use of the MOODLE LMS. Teachers interviewed were asked about aspects that contributed to them maintaining or sustaining their use of MOODLE. The focus group data contained in section 5.4.5 demonstrated that those staff using MOODLE responded positively, identifying it as a benefit within their classroom and a resource they would continue to use. This was due in part to their ability to select and change features for their classes. This aspect was found to be a desirable feature in using ICT within class. Furthermore, log data as presented in chapter 5 indicated the more frequent teacher users of MOODLE incorporated a wider variety of

functions. The features outlined below were identified as contributing to the sustainability *markers* identified previously and outlined in section 6.3.

Some of the features identified as beneficial and that helped develop sustainable usage for teachers include:

- Time dated assignment submission. This was identified as useful for accountability purposes especially for year 11 /12 students.
- Monitoring of students activity. Enabled some teachers to identify students not working productively on assessment tasks.
- Functionality statistics: the ability to identify resources that students use heavily.
- Resource repository / coherent framework. Teachers can deposit and access resources from any location and have the ability to modify course material easily.
- View resources other than text without using memory sticks.
- Self-marking exams. Helping to reduce teacher marking loads.
- Grade books. Helping to reduce the amount of manual data entry reducing time spent on administration.

### **Administrators**

This group responded positively as they were regular users of MOODLE in their classrooms and had developed a range of courses over a two year period. In summary, based on results presented in chapter 5, this group identified the LMS as offering:

- A coherent framework to present a sequence of activities for students.
- Access to features and documentation from MOODLE.org and online tutorials available.
- Statistics features very useful in tracking student usage and results.
- Growing number of free courses and resources available from universities using MOODLE.
- Collaborative nature developing within the school that has developed positive staff interactions surrounding MOODLE use.

This group identified most strongly the *changes in practice* for them as teachers. Within this group many had begun to incorporate the use of statistical features for their classes, accessing courses from different MOODLE sites around the world and generally engaging with wider networks than confining their practice just to Noosa District SHS.

As detailed in chapter 5 these staff helped to influence other staff and also adopted a role presenting professional development and mentoring others. These aspects were central to the development of the site management and operation, as well as the sustainability of MOODLE within the school.

### **6.3 Consideration of sustainability in the implementation of MOODLE**

As shown in chapter 3, Literature Review, the implementation of a sustainable site-based LMS necessitates the consideration of the structures that need to be developed to support teachers adopting MOODLE for their classroom. Specifically within the school context teachers need to be willing to undertake central roles in developing the LMS to share the knowledge, so improve the sustainability of the LMS. However, to implement MOODLE in a sustainable way *other* structures that help develop teacher and student practice need be considered and is discussed for the remainder of this section. As noted by Merkel et al.(2005) sustainability in this context involves, “finding ways to support groups as they learn about technology, as they identify ways that technology can be used to address organizational and community level problems, and as they develop plans to take on projects involving technology” (p. 6).

Sustainability is articulated by Merkel et al. (2005) as users having the ability and responsibility for maintenance, choosing functionality and control in designing the online environment within the class groups. Sustainable consumption, as outlined by Merkel et al. (2005) is an integral element of sustainable development and seeks workable solutions to social and environmental imbalances through more responsible behaviour from everyone. Within this school context the data indicates that the staff and students have taken on different roles that examine and develop ideas for course development. Student input is valued as a resource, acknowledging their daily interactions with technologies and the responsibility of students to help maintain and stimulate course development. In the implementation of MOODLE in this research, the following aspects were necessary for sustainable development as intimated in chapter 3 and demonstrated through the data in chapter 5.

- Networks – development of user networks and the collaborative actions that occur within the LMS
- Adaptations – adaptations of practices that incorporate ICT of users involved in the use of this LMS
- Scalability – the ability of the LMS to incorporate functions desired by participants and have the capacity to grow

- Governance – the willingness of participants to undertake tasks or roles willingly supporting the development of the LMS
- Site Activity – usage of the LMS both during school time and out of school hours.

These aspects form the basis used in structuring the presentation of the results in the following sections.

### *Networks*

Supporting development of user networks and the collaborative actions that occur within the LMS was considered as a key aspect helping to develop a sustainable approach for the use of MOODLE. Teachers in developing their ICT confidence and skills identified a number of *in house* strategies that could be developed. These are presented in chapter 2 and the results of these approaches detailed in chapter 5.

Initial in-services focussed on the development of a small group of teachers through attendance at MOODLE sessions held in the school IT laboratories. The focus of these sessions was to present information and a focus on enabling teacher skills. Based on staff feedback, these sessions proved successful (School Opinion Survey, 2005) and resulted in developing a small group of teachers with enough confidence to undertake the role of site administrator helping to select and trial core features of MOODLE within online courses.

This initial group then trialled their courses and their ideas helped stimulate further topics for in-service sessions. This initial group also helped to recruit and serve as advocates for the use of MOODLE within this site. The advice developed from this group informed professional development strategies that helped facilitate implementation including:

- Presenting information surrounding professional practice and relating the professional development to something they are actually doing.
- Embedding staff IT development so that teachers are working on their own course during the training.
- Use of one-to-one tutorials utilizing the teacher aide resource available.
- Use of self-paced online tutorials (Atomic learning, Moodle.org)
- Use of an expert faculty development model to identify and develop one key person per staffroom.

These strategies helped develop the formal networks supporting MOODLE development which is important in the sustainability of the LMS. These were aimed at supporting the improvement of teacher skills in engaging students in using digital material both within class and from home. Networks as described in chapter 3 were central in developing staff use of MOODLE across faculties. The strategies employed in this research drew from research by BECTA (2008) in targeting PD that helps avoid the development of *silo*. This strategy was shown to enhance course design and development across a number of faculty areas. This core group of teachers were active in sharing their practice with each other and this in turn helped to develop skills. This strategy also helped develop a strong network that supported all faculties in the use of MOODLE and helped sustain feedback to administrators enabling timely responses for teacher users.

This research also found that some of the best learning stems from failure. The teacher group was learning from each other through engaging and experimenting with modules and plugins with students. Teachers were also noted to refer to wider networks of teachers' and access resources through online networking. In addition, as more teachers began to use MOODLE, their practices began to focus upon specific applications within subject areas.

#### *Adaptations*

Supporting the development of MOODLE were those teachers who made the decision to use online resources for their students. Teachers who initially used MOODLE identified a number of benefits for them by incorporating an LMS into their practice. These were

- the system easily accommodates the integration of existing resources created by staff, such as Word, PDF and PowerPoint
- the system contains a variety of embedded tools that are easy to use with existing resources that can be modified easily.

As revealed in the results in chapter 5 the first point was highly relevant for most staff. Teachers using MOODLE had created a number of resources that work for their students and wanted to know that these could be used and maintained for their classes. Resources however were modified by teachers as confidence and functionality grew. Regular professional development sessions included time devoted to sharing practice and also included access to quality tutorial resources (Moodle.org, Atomic Learning) enabling staff to learn at their own pace. Selecting this style of development strategy created a familiar environment and a sense of achievement that helped develop user confidence.

Table 5.12 outlined the development of the modules contained within MOODLE versions during the research period. Part of the strategy employed by teachers in selecting functions within MOODLE was to incorporate student feedback. Student feedback as detailed in section 5.4.3 points to the benefit of including student ideas in the development of course applications. This strategy is similar to that reported by BECTA (2008) concerning the importance of incorporating feedback in course design.

### *Scalability*

Scalability measures were used to support the technical development of MOODLE as detailed in chapter 2. It can be seen in Table 5.11 and in Table 5.12 that the discussions with participants and the resultant decisions taken, has enabled the MOODLE site to grow rapidly and provided users a dynamic set of functions. As outlined in section 5.4.4., the features offered at this site stem from two main development influences. The first is the core functions contained within this site via a Concurrent Versions System (CVS) feed detailed in chapter 2 to the parent site Moodle.org. This enabled automatic updates of core features within MOODLE. The second development influence arose from ideas that stemmed from discussions between students and teachers. Some teachers were noted by the researcher to use the feedback module to identify responses from students concerning features contained within courses. This feedback was then reported to the site administrators and used to help identify problems and to resource new modules or plugins that could incorporate the feedback suggestions from classes. This practice helped promote governance at a class level helping locate decision-making within classes concerning resources and modules used.

Focus groups identified that this level of decision-making helped to promote sustainable practice for both staff and students. Governance as described in chapter 3 concerning the willingness of participants to undertake tasks or roles supported the development of the LMS. Governance in this research was found to promote usage and in part helped promote teachers accessing the variety of modules and plugins available. This was a consideration as MOODLE was selected for its active online community (MOODLE.org, 2009) and collaborative development partners, which help maintain and enhance functions within MOODLE. As shown in chapter 5, some staff involved themselves within MOODLE.org to source ideas from this site, and new ideas were discussed with teachers from NDSHS. The result of these discussions helped develop a series of

modules and plugins changes reflecting a more interactive functionality within course design for this site.

### *Governance*

Within the context of this research, markers of sustainability identify practices that improve the features and usage within this site. Governance, as identified from the literature concerns the *control* afforded to users within this MOODLE site. Here administrators were challenged to support the development of teacher and student users. The role of an administrator within the MOODLE LMS was largely that of helping others to explore new functions and help develop the site. Trialing modules and plugins or undertaking research to identify new applications to incorporate within courses is an important developmental role. Permissions (MOODLE, 2009) for an administrator allow access to all resources and functionality that can change the site's conditions.

However in developing sustainability, the conversations with both teacher and student users of MOODLE were important in developing site usage. The success in involving all users in trialing and evaluating MOODLE features helped to involve participants in developing their courses. This strategy helped to improve the activity from all user groups as indicated from results in chapter 5. This influenced the activity within the site.

### *Site Activity*

Over the Action Phases described in chapter 2 and chapter 4, the deliberate strategies targeting sustainability improved the overall usage across all user groups. This information was used by teachers or administrators to discuss the deployment of some features (Journal function, Book) or to scale back the use of some other functions that data suggests are not being accessed (Workshop). This helps to maintain the site and reduce the incidence of resources not being used and taking up data space within the internal network.

The consistency of usage over time is a strong indicator of sustainability. Site activity recorded in the data logs was an indicator of this. Here site activity also helps evidence the development of networks both informal and formal and the nature of the interactions between users. This data supports the assertions made in developing structures supporting the deployment of the LMS.

#### **6.4 Place for a site-based LMS within EQ**

Meta-analyses of ICT initiatives world wide (OECD, 2007; BECTA, 2007) have predominantly been focussed upon presenting a systems approach. EQ (2009b) has developed a similar, comprehensive corporate framework developing a number of web-based applications for use under MOE. Chapter 2 outlined the EQ framework discussing the centralisation and standardisation of functions as they apply within the school setting. Administrative core functions like behaviour management, reporting or school record keeping benefit from a centralised system like MOE (2007).

None of these corporate functions locate ICT interaction between students and teachers. It is here where teacher pedagogy and the incorporation of technology with a view to engaging students' in practices that develops ICT usage needs consideration. The current EQ LMS approach is affected by issues such as Internet speed and the range of file types and sizes used (EQ, 2007a). In this respect it has been intimated by Oliver, (2005) that centralising resources such as an LMS divorce some teachers from developing the ownership and flexibility to incorporate students input in the design and critical use of ICT.

This case study has identified a number of themes that support this assertion and has identified factors that teachers recognize as important in having direct access to an LMS. These factors are

- Ownership
- Flexibility
- Software integration
- Connectivity and speed

As shown in chapter 3, there is limited research (OECD, 2007; BECTA, 2007) into how individuals and communities actually benefit through incorporating ICTs to become sustainable practice. However it is evident from this research that given favourable conditions as discussed in chapter 2 and reported in chapter 5, students and teachers will use a site-based LMS. When a supportive set of conditions are present students, teachers and administrators work together and benefit from using a site-based LMS. All groups confirm that the flexibility provided can promote a change in ICT uses to occur. This in turn may help develop and sustain conversations between students and teachers helping to stimulate actions in the selection of further research on features that enhance the site. This process can occur rapidly and is strengthened by having a site-based model operating as both a schools intranet and externally through the Internet (extranet).

## 6.5 School IT culture

As described in chapter 3, attempts to characterise school ICTs communities within educational literature (BECTA, 2007; Sévigny & Prévost, 2005; Siemens, 2004) show that there are similar challenges for students, teachers and administrators. One aspect described was developing a culture of use for ICTs within a school. Within this research as described in chapter 2, the development of a culture incorporating ICTs has mirrored the pitfalls and successes described by studies dealing with systemic IT deployment (Education Queensland, 2007) and site-based initiatives (BECTA, 2008). The research at this school site identified ICT usage as predominately basic access for ICT prior to the LMS initiative (School survey data, 2006). The challenge in developing a cultural change was to take the step toward “appropriation or strategic use, where an individual or an organization turns the technology toward their own purposes, and makes it their own. Within this research the challenge of “appropriation includes such things as putting local content on the Internet in local languages, or designing applications to meet specific organizational needs” (Surman & Reilly, 2003, p. 10).

Chapter 5 showed that strategies employed to instruct teachers in the use of MOODLE were driven by teachers themselves. The approach used was informed by the work of Hennessy and Deaney (2004, p. 1) who comment on ICT use of secondary teachers in the UK and say that teachers “...do not generally work alone; the subject department acts as a community sharing resources, approaches, cultural values and aims, and collaboratively-developed schemes of work”. Hennessy and Deaney (2004) further outline that teachers who work in this manner, are moving along a developmental continuum toward developing wider ICTs practice. Hennessy and Deaney (2004) see this stage as “one step on the way” and in keeping with the notion of *appropriation* described by Surman and Reilly (2003). One consistent concept employed at this site was individuals working together toward the improvement of the site globally. As a consequence, as shown in chapter 5, a culture that has developed at this site is based largely on concepts and ideas held by the groups involved. The influence that contributed to the development of this culture is summarised below.

### Students

- Specific technologies appeared to motivate students in particular subject disciplines, notably forum, glossary tools and chat. Reflective journals and blogs helped develop students’ work ethics.
- Learners engaged in courses that contained rich audio and video media.

- Consistently review features and functions contained within courses so online material presented does not become stale.

### **Teachers**

- Structured design helped students to prepare for a variety of activities and this assisted their understanding of the material they need to cover to achieve learning outcomes.
- Use of exemplar work to help *scaffolding* to develop high quality online course material.
- Shared practice between user groups to learn from successes or failures.

### **Administrators**

- Develop deliberate school policy of using the LMS through a staged approach.
- Support is needed from senior management for implementing new practices
- Realistic timelines (3 years in this case) need to be provided to allow the support structures and professional development to enculture users of ICT.
- Drive cultural change and new ways of working through a structure of self managed faculty-based curriculum teams. The view was taken that the teams have the same destination and support structures be developed to get there.
- Being creative, experimenting and delivering their lessons in novel ways.
- Listening to the views of learners to improve learning designs.
- Using communication tools to enhance relationships with users.

## **6.6. The school as a learning community**

Considered in chapter 3, Literature Review, is the concept of a learning community. The main goal of such a community is to create new knowledge and understanding in an environment where collaboration rather than competition is encouraged (Angelo, 2000). In the context of a school, this research seeks to explore the role of the teacher as a coach and role model for others in the design of an effective online environment (Angelo, 2000). As described in chapter 2 and reported in chapter 5, this research has identified the benefit of incorporating student ideas and input in the development of this community. Sévigny and Prévost's (2005) research about Learning Communities indicates that the underlying principle is that one person alone does not have sufficient knowledge and skills to respond to the complexities of our institutions and our societies. This research has shown that there is a need to develop internal school-based professional development approaches that source individuals and acknowledge their skills

(Kilpatrick et al., 2003). This approach enabled the development of like aspects within this site that reflect a *learning community*.

In developing this learning community it is important to consider using information collected by individuals from the community. Doing so helps to promote the practice of users within the site supporting ownership and helps to stimulate further discussion surrounding the development of user skills. In this regard often it is the student users who enable teacher users by *teaching* their skills to this group. This reciprocal interrelationship has enabled a number of changes to teacher pedagogy that has resulted in the development of improved resources contained within courses offered within MOODLE. The impact of these interactions has helped to foster practices that include skills for all users developing sustainable networks that include teacher and student.

### **6.7 Guidelines and key components for a sustainable LMS Implementation**

The results in chapter 5 and the conclusions drawn from findings as indicated in the preceding sections have been used as the basis for the guidelines aimed at providing essential information needed to implement a sustainable site-based MOODLE LMS at Noosa District SHS. The guidelines are intended to provide a reference point for schools especially those within EQ wishing to establish a sustainable site-based MOODLE deployment. Literature from EQ (2008b) surrounding ‘communities’ and their value for developing both student and school outcomes through promoting partnerships with the wider community helped inform the development of these guidelines. The guidelines have been formulated based on the implementation of MOODLE described in chapter 2, and the use of the literature contained in chapter 3 and the research results presented in chapter 5. These guidelines are grouped under seven broad aspects as follows:

Guideline 1: Involvement of stakeholders – all users need to be involved in the development of course features.

Guideline 2: Authentic links with classroom practice – ICT resources need to relate to classroom discussions and existing classroom activities.

Guideline 3: Trial using small group or class – a small trial group helps inform both what material can be used and how this material may be used. This in turn can form the basis of a wider trial.

Guideline 4: Technician knowledge – the technical support needs to be localised helping develop responses for the site users. The site-based approach allows for timely development.

Guideline 5: Technical provisions – adequate server and networked software need to be facilitated to sustain functionality of the LMS.

Guideline 6: Use of an in house professional development program – this need to be developed parallel with the ICT development trail.

Guideline 7: LMS selection criteria – the criteria used in selecting an LMS needs to consider the needs of the users, the purpose for use and the technical support needed to maintain the operation of the LMS.

Each of the guidelines, their purpose and reason for the guideline are summarised in Table 6.1. Each of the guidelines reflects a specific theme that has been developed from the literature concerning sustainability and draw upon the results of this research presented in chapter 5. The themes identified from the literature review in chapter 3 that contribute to sustainable practice are:

- Networks – development of user networks and the collaborative actions that occur within the LMS
- Adaptations – adaptations of practices that incorporate ICT of users involved in the use of this LMS
- Scalability – the ability of the LMS to incorporate functions desired by participants and have the capacity to grow
- Governance – the willingness of participants to undertake tasks or roles willingly supporting the development of the LMS
- Site Activity – usage of the LMS both during school time and out of school hours.

Table 6.1

*Guidelines for the Implementation of a Sustainable Use of MOODLE*

<b>Guideline</b>	<b>Aspect</b>	<b>Purpose</b>	<b>Reason</b>
<b>1</b>	Involvement of stakeholders	<ul style="list-style-type: none"> <li>• Establish ground rules</li> <li>• Establish trust</li> <li>• Seek administrative support</li> <li>• Establish site goals for the use of ICT</li> </ul>	<ul style="list-style-type: none"> <li>• Develop school focus</li> <li>• Identify key teachers for task</li> <li>• Needs identified by staff</li> </ul>
<b>2</b>	Authentic links with classroom practice	<ul style="list-style-type: none"> <li>• Articulate benefits with respect to reducing some administrative tasks</li> <li>• Seek to improve work practice through incorporating students as part of the design process</li> <li>• Promote pertinent use of technology</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce administrative tasks (marking / grade book)</li> <li>• Promote student input</li> <li>• Identify relevant technologies</li> </ul>
<b>3</b>	Trial using small group or class	<ul style="list-style-type: none"> <li>• Outline small developmental steps</li> <li>• Discuss results of resource development and usage by users.</li> <li>• Look for opportunities to incorporate exemplar resources from similar LMS platforms.</li> <li>• Celebrate successes</li> </ul>	<ul style="list-style-type: none"> <li>• Build team approach</li> <li>• Develop networks</li> </ul>
<b>4</b>	Technician knowledge	<ul style="list-style-type: none"> <li>• Source wide range of knowledge not just the EQ OC system</li> <li>• Talk with others who have established site-based LMS</li> </ul>	<ul style="list-style-type: none"> <li>• Minimize security risks</li> <li>• Access wider community solutions</li> </ul>
<b>5</b>	Technical provisions	<ul style="list-style-type: none"> <li>• Source up to date information regarding operating systems and security measures.</li> <li>• Review EQ system requirements and relevant policies for security and network requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Satisfy system requirements</li> <li>• Code of conduct</li> </ul>
<b>6</b>	Use of an in house PD program	<ul style="list-style-type: none"> <li>• Promote networks</li> <li>• Focus on teacher development and skills</li> <li>• Acknowledgement of skills developed by teachers</li> </ul>	<ul style="list-style-type: none"> <li>• Build school capacity for using ICT</li> <li>• Promote networks and communication</li> </ul>
<b>7</b>	LMS selection criteria	<ul style="list-style-type: none"> <li>• Use BECTA (2008) framework</li> <li>• Cross check with other examples E.g. Alvarado (2004)</li> </ul>	<ul style="list-style-type: none"> <li>• Source relevant information helping inform LMS choice</li> </ul>

Table 6.1 expands upon the aspects developed from the literature presented in chapter 3. The guidelines and the aspects presented seek to locate sustainability principles within the practice of teachers and students within this site. Within this research context, sustainable practices were developed through the consideration and use of these aspects in the development of formal structures, such as professional development and create the conditions necessary to promote informal interactions between users. This aspect was considered with respect to the features available within MOODLE like messaging or blogs allowing users to contact each other.

Table 6.2 outlines each aspect considered and seeks to give purpose by expanding on the decision making processes that were used to develop the MOODLE. Each purpose has explicit reasons provided detailing considerations from this research. Table 6.2 therefore presents the guidelines and the actions undertaken during this research. The guidelines were developed from the results detailed in chapter 5 and from ideas and strategies developed in chapter 2. The use of data gathered from the initial trial and from Action Phase 1 has enabled a summary of actions presented here in Table 6.2. Table 6.2 further presents some of the practical actions employed in developing the aspects associated with this site. Finally Table 6.2 outlines suggested steps for implementing the guidelines identified as summarised in Table 6.1.

Table 6.2

*Implementation of Each Guideline*

<b>Guideline</b>	<b>Aspect</b>	<b>Actioning of Guidelines</b>	<b>Reason</b>
<b>1</b>	Involvement of both student and teacher users	<ul style="list-style-type: none"> <li>• Run discussion forum or meeting with staff to promote the benefits of using a site-based LMS</li> <li>• Invite teacher participation for a trial. Keep the trial small</li> <li>• Source skilled individuals in this initial phase as they will be valuable resources for later, wider implementation</li> </ul>	<ul style="list-style-type: none"> <li>• Set site goals</li> <li>• Identify staff need in the uses of ICT</li> <li>• Establish development framework and approach</li> </ul>
<b>2</b>	Teacher determined authentic links with classroom practice	<ul style="list-style-type: none"> <li>• Examine the core functions of the LMS for usage in the classroom. Can these offer an improvement or an extension for current practice?</li> <li>• Use features that can benefit or reduce a classroom teachers workload</li> </ul>	<ul style="list-style-type: none"> <li>• Link within existing teacher pedagogical approach</li> <li>• Start with existing resources and build upon this base</li> </ul>
<b>3</b>	Teacher facilitated trial using small group or class	<ul style="list-style-type: none"> <li>• Operate a trial and present findings to the school management group</li> <li>• Use these results and feedback to help devise professional development models that staff can have input into</li> </ul>	<ul style="list-style-type: none"> <li>• Start small</li> <li>• Establish networks and peer groups within faculties</li> </ul>
<b>4</b>	Technician knowledge	<ul style="list-style-type: none"> <li>• Source wide range of knowledge not just the EQ OC system</li> <li>• Source a support network, e.g. Moodle.org</li> <li>• Identify and talk with others who have established site-based LMS regarding the successes and failures they have encountered.</li> </ul>	<ul style="list-style-type: none"> <li>• Involvement with expert community</li> <li>• Improve knowledge base</li> <li>• Currency of knowledge</li> </ul>
<b>5</b>	Technical provisions	<ul style="list-style-type: none"> <li>• Read and source latest specifications for current version of the LMS</li> </ul>	<ul style="list-style-type: none"> <li>• Minimise security issues</li> <li>• Develop a support</li> </ul>

		<ul style="list-style-type: none"> <li>• Read and source latest specifications for current security details for MOODLE</li> <li>• Consult with other sites</li> <li>• Liaise with more senior managers and systems technician</li> </ul>	<ul style="list-style-type: none"> <li>• base from peers</li> <li>• Involve key stakeholders</li> </ul>
6	Use of an in house PD program	<ul style="list-style-type: none"> <li>• Promote networks and teacher development with ICT skills</li> <li>• Celebrate success and acknowledge skills developed by teachers</li> </ul>	<ul style="list-style-type: none"> <li>• Develop school staff.</li> <li>• Focus development monies on school staff</li> </ul>
7	LMS selection criteria	<ul style="list-style-type: none"> <li>• Source a range of current evaluation framework (BECTA, 2008)</li> <li>• cross check with other examples e.g. Alvarado (2004)</li> </ul>	<ul style="list-style-type: none"> <li>• Wide research</li> </ul>

### 6.7.1 Necessary conditions to enable sustainable use of an LMS in schools.

Broad literature studies were used as a basis for this research. For example BECTA (2008) and OECD (2007) identified a number of barriers for successful integration of ICT. More specifically, “cellular classroom organization, tight time scheduling and departmental boundaries that characterize secondary schools, along with the demands of curricular coverage and assessment, may both inhibit the use of technology in classrooms and retard widespread changes in teaching practice” (Hennessy & Deaney, 2007, p. 67)

In establishing a localised sustainable LMS, the necessary conditions require a clear identification of the purpose for use. The conditions that existed within this school context as described in chapter 2 for the implementation of MOODLE were as follows

- *Identification of school problem:* School generated data needs to inform a change in school practices. In the case of this research, school opinion data (2006) identified teachers were dissatisfied with ICT delivery and access within NDSHS. Similarly, students identified their dissatisfaction with classroom activities for learning. Schools need to develop the capacity to respond with evidenced-based practice to change practice for their school sites.

- *The needs identified by staff.* Information contained in Table 6.1 and Table 6.2 outlines the conditions as identified by NDSHS staff that can contribute to a sustainable implementation of MOODLE. In this respect a critical factor identified by staff is their attitude toward MOODLE. In this regard the specific development and need to source ICT solutions is *driven* by the staff within the school site. This aspect was deemed important within this research context as teachers wanted to develop solutions of benefit for them.
- *Leadership and support by the Principal.* This is needed to develop relationships between students and teachers using ICT in the classroom. School opinion data detailed in chapter 2 helped establish this trial. The Principal supported the incorporation of ICT practice within the classroom context helping to utilise ICT as a positive factor developing the relationship between student and teacher. This was described further using literature concerning sustainability as the aspects considered important supporting classroom relationships
- *Student teacher interactions.* In the context of this research engagement between students and staff members was essential to address ICT usage. Sustainability literature presented in chapter 2 and within chapter 3, was used to develop a framework for the incorporation of professional development cycles that promoted ICT use. Student feedback is essential within this framework helping to identify technologies that students would use. Data logs detailed in chapter 5 were important as a source of evidence identifying what resources were useful by students. Schools wishing to change practice need to identify means of gathering evidence helping inform decisions made regarding the change process in using ICTs.

Conditions exist within EQ that promote the implementation of ICTs for the classroom. The computers for teachers' trial (C4T) implementation described in chapter 2, and the infrastructure spending by EQ has enabled schools to focus on using the corporate systems. The computer for teachers (C4T) initiative has allocated one laptop for every teacher working above a 0.4 full time equivalent. Provision of these laptops and the subsequent system changes concurrent with the C4T initiatives are the implementation of OneSchool features as outlined in chapter 1. These EQ initiatives are helping to shift ICT use locating corporate ICT functions within teachers' daily practices. EQ has made the use of these corporate systems mandatory within all schools in Queensland. The area that this research focuses upon is the application of ICT to improve the use of ICTs within classroom practices.

### **6.7.2 Technical considerations and technician skills knowledge**

The technical considerations outlined within chapter 4 namely technical support for teachers and students and knowledge base of the technician necessitates consideration of two key factors. These two factors were critical in achieving sustainable development of MOODLE at this site.

- The technical support for staff and students.  
This support needs to be available within the school site. Within this research, the Initial Trial, Action Phase 1 and Action Phase 2 were technically supported by the school OC holder. In this regard this research would have been difficult as members of staff were neither cognisant nor skilled with the technical requirements needed to facilitate the implementation of the functions teachers identified for use. Within Action Phase 3 a teacher transferred into the school helped with this role. The transfer of a graduate student with a background in IT helped enable teachers wishing to use more complex modules and plugins. The benefit of having site-based staff supporting ICT development helps further maintain the networks within the school community.
- The knowledge base of the school technician.  
The current EQ supported OC training only focuses upon EQ corporate applications. This reduces the likelihood of change within the system. This research has identified the technical parameters for installing and operating MOODLE (Appendix A) and this documentation provides specific data for this site only. There are other considerations that may be employed successfully but the operating system and security measures employed reside with the technical knowledge of the site-based person or what a school is going to provide through employment of a consultant. These are two key considerations in undertaking a site-based operation of an LMS

### **6.8 Limitations of the study**

The use of a case study methodology for this research has been a limitation. This type of research method has been criticised as narrow, focussing on only the subject or phenomena present at that point in time. Prominent research methodologists for example Yin (2003), Denzin and Lincoln (2000) identify case study research as having a lack of breadth offering little grounds for establishing reliability or generalisability of findings. This is often due to results being non-numerical with limited means for obtaining results that are representative of a wider population. This research has focussed on a particular site at a particular point in time. The data gathered has been numerical via data logs, helping establish patterns for use within this community. Data has

not been generalised moreover has been used to develop a set of guidelines for use within schools.

The data obtained in this research has been limited to that gathered from individuals who knowingly and willingly chose to participate in an online community established at this school site. As well, as discussed in chapter 3, the technical data that has been described has a finite life as the changes to operating systems within EQ and security arrangements are ongoing. MOODLE being an open source product also changes rapidly with new features being upgraded or altered based upon community need. Changes during the investigation also have been made to meet with the EQ requirements for security. The implications for this research had the following specific limitations:

1. The research concentrates only on the use of MOODLE at this site. The results of the investigation are therefore specific to the implementation and use of MOODLE at this secondary school.
2. The data collected from the observations and statistics are limited to participants from this school.
3. The type of data sources obtained was both qualitative and quantitative concerning students, teachers and administrators.

The research has particular significance in the context of how ICTs are delivered within a school context. The investment into EQ corporate ICT infrastructure and the associated professional development agenda locates ICT use as central within student learning. Therefore this research has described how this may occur through the use of an LMS to frame and deliver ICT working with students.

The research questions presented in chapter 1 focus upon the development of networks within a school and the aspects of teacher practices that help develop sustainable ICT practice.

## **6.9 Areas for further research**

The major aim of this research has been to explore aspects that promote sustainability within NDSHS.

The limitations of this study presented in chapter 1, provide a start in developing areas for further research. Based on the results of this study, it is recommended that any future research seeks to

further discuss conditions surrounding the provisioning of a site-based LMS using the existing MOE infrastructure.

- The facilitation of other schools to trial the operation of a site-based LMS needs further consideration as it will support the technical development and provide evidence for the development of a school-based LMS.
- Role of PD to achieve sustainable LMS use.
- Sustainability is another area identified for further research. Identified within this research were aspects that were used to underpin the development of approaches toward professional development. Chapter 5 results indicate these approaches have been in this instance successful, but further research is warranted to establish if these conditions can be replicated.
- Within this research what constitutes a Learning Community as it applies to this context needs exploration. The conditions of “trust, reciprocity and teamwork” outlined by Sévigny and Prévost (2005, p. 4) have been used to underpin strategies in establishing ICT practices. These values need to be supported and explored as results from this research may be used to inform wider ICT practice, helping develop teacher and students partnerships in developing and selecting ICT for learning.
- How students engage with their teachers using an LMS and how this effects the interaction between these groups.
- The continued incorporation of ICT within pedagogy
- How students that have used an LMS within this framework will then engage in higher education.

Some results obtained in this research as detailed in chapter 5, outline evidence of teachers developing wider community networks and practices using ICT independent from school-based professional development. How these teachers identified and importantly why these teachers sought to utilise networks external from EQ can evidence alternate practices. This usage of wider networks has been identified (OECD, 2007) as a contributing factor in establishing sustainable practices that help to promote innovation and longevity. The impact of wide networks is an area that is not widely promoted within the EQ framework and as it relates to this research, has been shown to promote enhanced practice for some MOODLE users.

## **6.10 Concluding remarks**

This research sought to develop a set of guidelines for the implementation of a school-based LMS. The dissertation, on the basis of the findings, has developed a set of guidelines for this purpose. The dissertation also delineates the steps required to manage the change that is required for implementation.

Concerning the use of a centralised approach by EQ in the provision of an LMS for school, this research has shown the benefits of a site-based LMS. This research has demonstrated the efficacy of this school's site-based model for an LMS. This case study has demonstrated the rich interaction that occurs when both teachers and students work together for mutual benefit. Strategies that help members engage in a broader community help develop ideas and practices and maintain EQ within a global community. This research also offers the opportunity to explore different modes of practice using an LMS within the MOE environment operated by EQ. Further research needs to occur surrounding highly innovative schools successfully using ICT to reinforce their existing teaching and learning.

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## Appendix A

Installing Moodle as a Debian package

Using apt-get, aptitude or Synaptic

Make sure your PC connected to the Internet. (Moodle has been included with Debian Sarge. You don't need net connection, if you have the Debian Sarge CDs or DVDs that are configured as download repositories for apt-get, aptitude or synaptic). Use one of these:

apt-get install moodle

aptitude install moodle

Run the synaptic package manager and search (Ctrl + f) for "moodle" (without quotes). You will get moodle in the results (if not, you need to configure your download URLs). Right click and select "Mark for Installation". Click "Apply" button on the Toolbar.

Answer the questions asked by the installer (such as the database to be used - MySQL or PostgreSQL).

Visit your moodle site at <http://localhost/mymoodle/admin>

Manual download

You will probably need to follow this, if you don't have Internet connection on the PC on which you want to install moodle.

Download moodle and all the dependencies (if you already don't have them) from

Stable(<http://packages.debian.org/stable/web/moodle>) or

Testing(<http://packages.debian.org/testing/web/moodle>). Place them all in the same directory (no matter which).

As root, run the following command:

```
dpkg -i *.deb
```

This will unpack and begin the installation of all the downloaded packages.

Answer the questions asked by the installer (such as the database to be used – MySQL or PostgreSQL).

Visit your moodle site at <http://localhost/mymoodle/admin>

Installing moodle from .tgz(.tar.gz) or .zip file

More detailed instructions coming soon

You will probably want this if you don't like the settings of Debian moodle package.

Step 1: Install required packages

Install these packages (if you've not already done so). See Installing Apache, MySQL and PHP or refer to the respective user manuals. Using apt-get, aptitude or synaptic you can install these very easily.

Web Server (Apache highly recommended)

Database Server (MySQL or PostgreSQL recommended)

PHP, PHP-MySQL mod (or mod for your database)

These packages are optional:

GD library

LAMP in Debian Etch

Setting up a LAMP in Debian is very easy. Once you get used to Debian administration including installation and configuration are much simpler compared to other linux distros. The following describes how to install apache, php and mysql on the Debian testing distribution called etch. Etch is expected to be released in December 2006.

For installation of the necessary packages the easiest option to use apt-get.

Use the following command to install apache2, php5 and mysql

```
apt-get install apache2 php5 mysql-server php5-mysql libapache2-mod-php5 php5-gd  
php5-gd is optional
```

The mentioned packages are installed along with the dependencies depending on what was already installed on your Debian system.

Now you may fire up a browser and type localhost to check whether the apache2 default page is shown,

You can edit the apache configuration files using the text editor gedit by

```
gedit /etc/apache2/apache2.conf
```

Now we must make a slight change in the php5 configuration file. Open it using

```
gedit /etc/php5/apache2/php.ini
```

add the entries

```
extension=mysql.so
```

```
extension=gd.so
```

Sometimes these entries are provided as example lines being commented out . You can remove the commenting to activate the entries.

To test the php installation, you can create a text file named phpinfo.php with the contents `<?phpinfo()?>` and save it at /var/www. Now access this file through the browser localhost/phpinfo to check the installation of php. Mysql installation is already there. Give it a root password using

```
mysqladmin -u root password "yourpassword"
```

You can restart apache 2 by

```
/etc/init.d/apache2 restart
```

You can restart mysql by

```
/etc/init.d/mysql restart
```

Step 2: Download moodle

Download moodle from <http://download.moodle.org/?lang=en>.

Step 3: Unpack file

For zip file, use `unzip <your_file>`. For `tgz(tar.gz)`, use `tar -zxvf <your-file>`. You can also use any of the GUI front-ends such as file-roller or ark. You will get a folder moodle (or moodle-1.5.2 or something similar).

Now, suppose you want to install moodle at /var/www/moodle (This means moodle will be accessible at <http://localhost/moodle>). `mv moodle /var/www/` (Most probably you will need to be root to do this)

Step 4: Start web and database servers

Login as root (if you have not already done so): su.

Start your web server. For Apache2, /etc/init.d/apache2 start.

Start your database server. For MySQL, /etc/init.d/mysql start

Step 5: Finally install

Go to <http://localhost/moodle> and follow the instructions.

Installing Moodle from CVS

To get the most stable current version of Moodle, you will want to install it's scripts directly from the CVS, the versioning system used in the development of Moodle. Using the CVS also allows you to regularly update Moodle with the most recent bug fixes and features.

For these instructions, you can install Moodle with only the minimum of Debian features installed, keeping all the resources available for the server if you wish.

Install php, MySQL and other needed components

Logged in as the root user (or use the Linux "su" command to get root privileges) download and install other required software for Moodle (about 41 MB)

```
apt-get install apache2 php5 mysql-server php5-mysql libapache2-mod-php5 php5-gd php5-curl php5-xmlrpc cvs
```

If you use additional authentication methods, you may need to install other php libraries, such as php5-imap if you use IMAP to authenticate your users.

Setup MySQL Database

Set a secure root password for the database

```
mysqladmin -u root password "mySecurePassword"
```

Note that on a secure production server, you will want to create a different user than root to access the database.

Now log in

```
mysql -u root -p
```

Enter your password

Create the Moodle database

```
mysql> CREATE DATABASE moodle;
```

```
mysql> exit;
```

Get Moodle from CVS

Go to the directory where Moodle will be installed.

```
cd /var/www
```

Get the latest version of Moodle 1.9 (check for the most recent released version or the version you are most comfortable with. It may be earlier or later than 1.9 stable. Use the European Union CVS server (you can replace eu with uk, es, or us in this step if you wish)

```
cvs -z3 -d:pserver:anonymous@eu.cvs.moodle.org:/cvsroot/moodle co -r
```

```
MOODLE_19_STABLE moodle
```

Create a data directory and set Moodle directory permissions

Create a directory for user and course files (you should still be in the /var/www directory)

```
mkdir moodldata
```

Set permissions so that Apache can access the files

```
chown -R www-data:www-data moodle
```

```
chown -R www-data:www-data moodledata
```

On a production server, you may want to tighten up privileges further.

Change Apache to use Moodle as the web site

Note that the server comes with Apache running and looking at the /var/www directory. But there is nothing in that folder, so one just gets a redirect. Edit as follows to have it point at Moodle instead:

```
nano /etc/apache2/sites-available/default
```

On about line 4, change DocumentRoot "/var/www/" to

```
DocumentRoot "/var/www/moodle/"
```

On about line 10, change <Directory "/var/www"> to

```
<Directory "/var/www/moodle">
```

Around line 17, comment out the line for the default page:

```
# RedirectMatch ^/$ /apache2-default/
```

You can change other values like ServerAdmin if appropriate. For all changes, you should restart Apache for the new settings to take effect.

```
/etc/init.d/apache2 restart
```

### Setup Moodle

If you are only going to test Moodle on your internal network, just enter the local IP address as the web address. You can find the local IP address under DHCP by typing

```
ifconfig eth0
```

If you have a web address that points to your server, use that instead.

From a browser on another machine, enter

```
http:// ---- your web address ----
```

For the database user, enter root

For Password, enter the password for the database that you created earlier

Continue through the dialogs and select Unattended operation and set up the Moodle server.

### Install cron

Moodle needs a periodic call to do maintenance work like sending out emails, cleaning up the database, updating feeds, etc. To run the cron every 10 minutes, do the following

Rather than learning vi, use the nano editor

```
export EDITOR=nano
```

Edit the cron file

```
crontab -e
```

Add this line and save.

```
*/10 * * * * wget -q -O /dev/null http://localhost/admin/cron.php
```

Use CNTL-X to save

### Other recommended settings

Next, make three changes to php.ini

```
nano /etc/php5/apache2/php.ini
```

This will allocated more memory and allow files to be uploaded up to 80MB. This should be enough for most multi-media files. Hard drive space is cheap and the default is only 2MB. It is recommended that you change the settings to the following values:

```
memory_limit = 40M
```

```
post_max_size = 80M
```

```
upload_max_filesize = 80M
```

Updating from CVS

To update with the most recent fixes to Moodle, issue the following commands

```
cd /var/www/moodle
```

```
cvs -q update
```

## **Appendix B**

### **Focus Group Information**

#### **INFORMATION SHEET – FOCUS GROUPS**

#### **RESEARCH PROJECT – MOODLE AS A SUSTAINABLE LEARNING**

#### **MANAGEMENT SYSTEMS IN A SCHOOL COMMUNITY**

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##### **Information for Research Participants**

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This project was initiated as an enhancement to ICT delivery at an Education Queensland High schools in 2006. The project developed into the subject for an EdD project. The key theme of the research is 'sustainability' and this research will examine the e-learning community that develops at this site using a MOODLE Learning Management System.

This research will document the steps taken in the implementation of MOODLE and explore the effects of MOODLE on the schools teaching and student communities and describe changes to teaching practices that may occur, helping develop a wider understanding of a sustainable ICTs community. As such Education Queensland has approved this trial.

The research intends to achieve the following outcomes.

- Undertake a case study to document for students and teachers reactions to using MOODLE in the school community.
- Based on the analysis of the data from the case study, develop a set of guidelines for schools to implement their own web portal.
- Outline changes in classroom practices that can occur using an LMS that increase 'ownership' of online courses that engage both teacher and student in sustainable practices that help online course development.
- Document the technical and operational parameters that will enable sustainable use of Moodle at this site.

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##### **How does it work?**

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Participation in this research is voluntary and any information that you provide will remain anonymous. Your name will not be recorded for this research. You have the right to withdraw from the study at any stage and the right to refrain from answering any question if you wish to do so. You will be required to provide your consent in writing to participate in this study. This means that you must sign a 'consent' form. Signing this form means that you have agreed to be a part of the project, however it does not stop you from changing your mind and withdrawing from the research at any time. Information gained during the study will be used for a Doctor of Education degree and may also be published in research and conference papers.

Participants in Focus Groups:

- Focus groups will take no longer than 30 minutes.
- Participants will answer questions
- Responses will be recorded
- Interviews will occur during school hours

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### **Confidentiality**

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The data collected for this project is subject to the University's Code of Conduct. All data relating to the research project will be retained for a period of five years, and will be stored in a secure location, in a locked filing cabinet in a secure office.

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### **Information and Concerns**

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If you would like more information about the project you can write, telephone or email the investigator,

**Mr Greg Wilson**

HOD

Noosa District State High School

Phone: 5472 2222

Email: gwils36@eq.edu.au

or the Doctoral Supervisor(s)

**Professor John Dekkers**

Faculty of Arts, Business, Informatics and Education

CQUniversity, Noosa

Phone: 07 5440 7000

Email: j.dekkers@cqu.edu.au

**Professor Bruce Knight**

Faculty of Arts, Business, Informatics and Education

CQUniversity, Rockhampton

Phone: 07 4940 7544

Email: b.knight@cqu.edu.au

Should there be any concerns about the project, please contact CQUniversity's Office of Research: Office of Research, Building 32, CQUniversity, Bruce Highway, Rockhampton Q 4702

Phone: 07 4923 2607, Fax 07 4923 2600. E-mail: research-enquires@cqu.edu.au

## Appendix C

### Information Sheet for Interviews



NOOSA DISTRICT STATE HIGH SCHOOL

Tulip St, COOROY QLD 4563

Postal Address: PO Box 564, COOROY QLD 4563

Telephone: (07) 5472 2222 Fax Number: (07) 5472 2200

Website: [www.noosadistrictshs.eq.edu.au](http://www.noosadistrictshs.eq.edu.au)

Email: [office@noosadistrictshs.eq.edu.au](mailto:office@noosadistrictshs.eq.edu.au)

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14 – 03 - 09

#### Project Description:

This project was initiated as an enhancement to ICT delivery at an Education Queensland High schools in 2006. The project developed into the subject for an EdD project. The key theme of the research is 'sustainability' and this research will examine the e-learning community that develops at this site using a MOODLE Learning Management System.

This research will document the steps taken in the implementation of MOODLE and explore the effects of MOODLE on the schools teaching and student communities and describe changes to teaching practices that may occur, helping develop a wider understanding of a sustainable ICTs community.

Case Study methodology was chosen as an appropriate method to explore and examine the research questions. This particular methodological approach will be suitable to provide a framework that involves research in and with a community in the adoption and modification of ICTs. The research intends to achieve the following outcomes.

- Undertake a case study to document for students and teachers reactions to using MOODLE in the school community.
- Based on the analysis of the data from the case study, develop a set of guidelines for schools to implement their own web portal.
- Outline changes in classroom practices that can occur using an LMS that increase 'ownership' of online courses that engage both teacher and student in sustainable practices that help online course development.

- Document the technical and operational parameters that will enable sustainable use of Moodle at this site.

A plain English statement regarding this research is available upon request.

Yours truly,

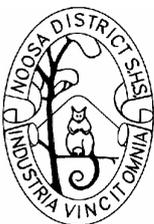
A handwritten signature in black ink, appearing to read 'GW', with a long horizontal flourish extending to the right.

Greg Wilson

Research Student CQ University

## Appendix D

### Consent Form



NOOSA DISTRICT STATE HIGH SCHOOL

Tulip St, COOROY QLD 4563

Postal Address: PO Box 564, COOROY QLD 4563

Telephone: (07) 5472 2222 Fax Number: (07) 5472 2200

Website: [www.noosadistrictshs.eq.edu.au](http://www.noosadistrictshs.eq.edu.au)

Email: [office@noosadistrictshs.eq.edu.au](mailto:office@noosadistrictshs.eq.edu.au)

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14 – 03 - 09

### CONSENT FORM FOR PARTICIPANTS - TEACHER

#### **PROJECT: Moodle as a sustainable Learning Management System in a school community**

##### **Project Description:**

This project was initiated as an enhancement to ICT delivery at an Education Queensland High schools in 2006. The project developed into the subject for an EdD project. The key theme of the research is 'sustainability' and this research will examine the e-learning community that develops at this site using a MOODLE Learning Management System.

Sustainability was chosen as the literature intimates there is little documented research regarding the sustainable use of an LMS in Education Queensland schools. This research will document the steps taken in the implementation of MOODLE and explore the effects of MOODLE on the schools teaching and student communities and describe changes to teaching practices that may occur, helping develop a wider understanding of a sustainable ICTs community.

Case Study methodology was chosen as an appropriate method to explore and examine the research questions. This particular methodological approach will be suitable to provide a framework that involves research in and with a community in the adoption and modification of ICTs. The research intends to achieve the following outcomes.

- Undertake a case study to document for students and teachers reactions to using MOODLE in the school community.

- Based on the analysis of the data from the case study, develop a set of guidelines for schools to implement their own web portal.
- Outline changes in classroom practices that can occur using an LMS that increase ‘ownership’ of online courses that engage both teacher and student in sustainable practices that help online course development.
- Document the technical and operational parameters that will enable sustainable use of Moodle at this site.

A plain English statement of results regarding this research is available upon request.



Greg Wilson  
EdD candidate



Cate MacMillan  
Principal  
Noosa District SHS

## CONSENT FORM FOR PARTICIPANTS - TEACHERS

Dear Teacher

You are being asked to participate in a research project being conducted at Noosa District SHS. This project has a focus on the use of a Learning Management system to extend the classroom beyond the traditional school fence. Resources will be developed that can be accessed from home via the Internet. These resources may include revision exams, report templates or instructional video. Participation is voluntary.

- I agree the nature and purpose of the study has been explained to me and I agree to participate.
- I understand that the information gained during the study will be used within the EdD thesis and may be published
- I understand that I will not be directly identified by name in any publications
- I understand I can withdraw from the study at any stage.
- I understand that I can refrain from answering any questions should I so wish.
- The data collected for this project is subject to the Code of Conduct and the requirement that all data relating to this research be retained for a period of five years, and be in a secure location, in a locked filing cabinet.
- I understand a plain English statement of results is available upon request.
- Education Queensland is supporting this trial

I give permission to participate in this research project. I have read the information above and give my consent to participate.

Name: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_