

Science and Mathematics Education Centre

**Diffusion of ICT in Education and the Role of Collaboration:
A Study of EdNA**

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature: 

Date: 25 February 2010

Abstract

This research explored the diffusion of information and communications technology (ICT) innovations in education through a case study of Education Network Australia (EdNA) spanning fourteen years since EdNA's establishment in 1995.

The study began by developing a comprehensive and original chronological history of the establishment, development and management of EdNA, with a particular focus on the collaboration amongst stakeholders in all of these phases. Four research questions were developed for the study to address. Evidence from documentary analysis, interviews with stakeholders and personal recollections was triangulated in addressing those questions.

From a theoretical point of view, in the absence of theory specific to diffusion of ICT innovations in education, the research used as a theoretical starting point the work of Rogers (2003) on diffusion of innovations more generally. The analysis and interpretation of the literature related to Rogers' theory highlighted that the likelihood of success of an innovation appears to be linked to its antecedents and pattern of its take up.

An additional dimension of the theoretical framework of this study concerned the concept of collaboration amongst stakeholders – demonstrably a key concept in relation to EdNA, but one which has been very poorly defined in the literature. This study therefore developed a clear definition of collaboration in education for application to large scale projects such as EdNA, distilling the definition and characteristics of collaboration from previous work by Education.au Limited (2004) and Clark (2008).

The above led to the theoretical proposition that *the successful diffusion of an ICT innovation in education can be judged by its antecedents, its rate of population take up and the strength of collaboration associated with it*. This theory was tested through a detailed analysis, using evidence from the EdNA case study.

The findings of the study were that the new theory provided a robust basis for analysis of the diffusion of EdNA and the role of collaboration in that diffusion. Specifically, collaboration was found to be strong at high levels of influence (senior officials) in the establishment phases of the development of EdNA with leadership from the Commonwealth and a commitment to the initiative by State education and training Ministers and their senior staffs. The indicators of the likelihood of success were in place within five years after which time the national bodies sought a wider education technology agenda. The national initiative then operated by cooperation (Himmelman, 1993) for a short period before moving to coordination by Education.au as the managing body in consultation with the Commonwealth and the States. During the coordination period innovation with EdNA services and new social technologies deployed on EdNA were strong and led to the emergence of online collaboration among users.

The shift from national collaboration at a high level of influence in establishing the EdNA initiative to online collaboration among users as a result of innovation supports the proposal that collaboration in education is the process of co-creating knowledge while sharing physical or virtual space. However, this research did not support the view that the role of collaboration, beyond the establishment of the initiative, had a positive effect on the diffusion of ICT innovations in education because intensive collaboration is very demanding in terms of time and resources.

This study addressed major theoretical and analytical gaps in the literature on diffusion of large-scale, national ICT innovations in education. It provides a sound basis for future research and practice.

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Chapter 1 Introduction

Context, background and purpose of the study

The quest for education to come to grips with the beneficial and educational uses of information and communications technologies (ICT) gained momentum with the invention of the World Wide Web (WWW) in 1989 and continues to the present day. The WWW together with email provided the capacity to communicate and share resources across geographical boundaries, regionally, nationally and globally, especially with the release in 1992 of the first internet graphical browser Erwise (Gillies and Cailliau, 2000).

Internationally, the education-related potential of the WWW was realised by different countries in a variety of ways. In 1998, the UK initiated the National Grid for Learning which, by 2001, had a budget of £245 million over two years (Department for Education and Employment, 2001). The European Schoolnet (EUN) started in 1997. The inaugural Executive Director commented:

The first year it was run and paid for by the Swedish Ministry of Education and the small two-person staff had its office at the Ministry. The web site was run by a contractor. In June, 1998, the members of the EUN agreed on the statutes to set up EUN as a European organisation and the EUN Office in Brussels started to operate from September, 1998. (Lundin, 2010, p.1)

By 2006, the funding for EUN staff and operational costs was €2,421,000 (European Schoolnet, 2006). Canada initiated a \$1.6 billion national education connectivity program over four years in 1993 (Mappin, 1995) and in the US the International Society for Technology in Education (ISTE) and the Consortium for School Networking (CoSN) nationally harnessed technology teachers and education technology leaders respectively to focus on the WWW.

In Australia, education policy makers took the decision to develop Education Network Australia (EdNA) as a result of a report called *Networking Australia's Future: Final Report* (Australian Government, 1994) which was stimulated by the Prime Minister's Science, Engineering and Innovation Council chaired by The Hon. Paul Keating. As one respondent to interviews conducted as part of this study recalled:

The Prime Ministers science and engineering group (sic), which met twice a year, ... first looked at... the internet at one of those meetings, ... [in] the middle of 1994. (Respondent D)

EdNA was developed as a specialist national educational online service to provide quality selected and evaluated digital resources, education information services, and collaborative services. It was established in 1995 (Hesketh, Gosper, Andrews, and Sabaz; 1996) using the international online education technical standard Dublin Core¹ (DCMI) metadata (Mason and Ip, 1998) and guided by IMS Global Learning Consortium² best practice (Mason and, 1999). Collaboration was fundamental to EdNA's development and operation as indicated in documentation disseminated at the time of EdNA's establishment (Mason and Ip, 2000, Education.au, 1998a; Gibbons, 1995a).

EdNA was one of the first national online education services in the world. As a large scale national online service, EdNA was governed, developed and managed through national collaborative processes by the Commonwealth and the States. It has been acknowledged as one of the most comprehensive national services for education and training, and attracts considerable attention from major international groups. For example, at the international *Global Summit-Technology Connected Futures* in Sydney in 2006, Bosco stated that:

Specialized information sources such as the excellently designed EdNA (developed by *education.au limited*) provide a model for mediating the vast

¹ DCMI was accessed on 27 June, 2007, from <http://dublincore.org/>.

² IMS Global Learning Consortium was accessed on 27th June, 2007, from <http://www.imsglobal.org/>.

resources of the Web with the needs of the clientele. In the case of EdNA the clientele is educators. (Bosco, 2006, p. 5-6)

During the fourteen years since its establishment in 1995, EdNA and other similar services have needed to operate in a rapidly changing online environment and remain state-of-the-art to attract and maintain users. Today's teachers have available to them a wide range of interactive social and information networking technologies such as *Wikipedia*, *FaceBook*, *MySpace* and *YouTube* as well as EdNA and its services for use in education with students. Virtual online communities (Rheingold, 2000) of educators are also active using *EdNA Groups* and similar types of online collaborative services. EdNA's developers and users have maintained a position of innovation in online education services, throughout its history.

The development outlined above has occurred in a context where there has been minimal opportunity to document, research and systematically analyse the process of development of education-related ICT innovations or to ensure that the process was informed by appropriate theory, as the author recalls. However, a study by Meredyth, Russell, Blackwood, Thomas and Wise (1999) did provide information and policy direction for a range of issues to plan for the 'equitable integration of information technology into Australian schools' (p. xxxii). In fact, the report stated that 'Teacher's knowledge of the potential of technology for enhancing outcomes is limited' (Meredyth et al, 1999, p.14). In reality, there were major gaps in both theory and practice in this area, in that the diffusion (or take-up) of digital services in education was poorly understood and under-theorised. In addition, in Australia, the persistent and structural idea of State and Commonwealth Governments working together, that is, collaborating, which was a requirement for developing EdNA from the very start (Gibbons, 1995a), has not been subjected to any critical analysis.

The research reported in this dissertation addressed these gaps. Its purpose was to advance understanding of the diffusion of ICT innovations in education, through the building and testing of theory, based on a case study of the history of EdNA. The theory-building and theory-testing in this research paid particular attention to the role of collaboration in the take up of ICT innovations, specifically, in the case of EdNA,

whether collaboration appeared to be a facilitator of success or a barrier to success of the take up.

Summary of this chapter

Following this introduction of the context, background and purpose of the research, this chapter provides an overview of the theoretical framework and methodology of the study, with comments also on its perspective and significance. This is followed by an explanation of the key terms and conventions used throughout this thesis. The key terms also describe the relationships and the bodies that were engaged with EdNA. Finally, the chapter concludes with an overview of the thesis.

Theoretical framework

The concepts of the diffusion of ICT innovations in education and collaboration are introduced here.

Diffusion of ICT innovations in education

The perspective of this study was on national system-wide diffusion of ICT in education, that is with large scale adoption of ICT innovations on an education system-wide basis, and an examination of the role of collaboration in that diffusion process. The literature search undertaken for this study revealed limited previous research on the large scale take up or diffusion of ICT in education over the last decade although there has been research into teacher concerns about the use of ICT, models of school change and the uses of ICT in education. Considerable research in education has been focussed on the implementation and use of ICT, and a number of models have been proposed. Trinidad, Newhouse and Clarkson, (2005), for example, has provided a useful summary of four different models of ICT integration including teacher concerns based models, technology models, school change models and population models.

In other disciplines, areas such as health, agriculture and business have focussed on diffusion of ICT but in contexts more concerned with products and solutions than with knowledge, interaction and learning which are relevant to education. Some reports, such as *Education at a Glance* from Organisation for Economic Co-operation and Development (OECD) provide statistics on the ratio of computers to students and the *Main Economic Indicators* provide data on access to computers and ICT by households. Although this information can be years old when reported, it nevertheless remains useful for country comparisons of computer and related ICT take up. For example, the *Education at a Glance* (OECD, 2001) reports on the ratio of students to computers between 1989 and 1998. A review of these data was useful in examining the diffusion of computers and ICT globally as well locally in education.

In general, much of the previous research in this area was not relevant directly to the concerns of this study. The focus here was not, as in much previous research, on how teachers, learners and researchers used ICT in education and the effect on learning outcomes. There is research in that area including the recent research of Moyle and Owens (2009) *Listening to Student's Voices* which elegantly summarises the learning benefits for students in using ICT.

In the absence of theory relevant directly to the diffusion of ICT innovations in education, the theoretical background for this study was based on the Everett Rogers (2003) more general theory of diffusion of innovation and on a review of the literature on collaboration. Rogers (2003) has led the research and work on the diffusion of innovations for several decades. He has argued that diffusion research was a form of communication research.

Diffusion research is a particular kind of communication research, but it began outside of the academic field of communication. (Rogers, 2003, p. 47)

In research spanning nearly four decades (1962-2003), Rogers developed a diffusion of innovation (DoI) theory which provided a useful, robust and descriptive theoretical starting point for this study and which, together with others' elaborations

(as discussed in Chapter 3) appeared to assist understanding of the critical success factors and barriers in the take up of ICT in education. Using and modifying Rogers' theory of diffusion of innovations and identifying the gaps of collaboration and leadership in its application to education, a new theory for diffusion of ICT in education was developed in this study. It was then tested by examining the likelihood of success and the take up of EdNA as an indicator of the take up of ICT in education. Rogers' theory (2003) of diffusion of innovation provided a sound basis for this research by providing an accepted and mature theoretical, descriptive framework which could be applied to studies of ICT in education.

There are a number of criticisms of Rogers' DoI theory especially its weakness to predict innovation take up, its North American cultural specificity and its bias towards successful innovation. Many of these criticisms have come from marketers and economists who seek to use DoI theory as a method to predict the take up of an innovation or a new product.

Although Rogers' theory is strong as a descriptive tool, the criticism remains that for prediction of innovation take up and methods to increase the rate of take up, Rogers' theory is less strong. Clarke (1999) said that:

DoI Theory is at its best as a descriptive tool, less strong in its explanatory power, and less useful still in predicting outcomes, and providing guidance as to how to accelerate the rate of adoption. There is doubt about the extent to which it can give rise to readily refutable hypotheses. Many of its elements may be specific to the culture in which it was derived (viz. North America in the 1950s and 60s), and hence less relevant in, for example, East Asian and African countries, and as time goes on. (Clarke, 1999, p.1)

The cultural criticism by Clarke (1999) is not sustainable when one considers the considerable number of DoI studies undertaken throughout Asia, South America and Africa that replicate Rogers' theory. Although Rogers (2003) argues that the consequences of innovation in different cultures need to be judged by the norms, values, beliefs and attitudes both the US and Australian schools education systems are state-based within federal arrangements. However, there is agreement that

Rogers' theory is not especially strong in its explanatory power and it is less useful in predicting outcomes (Trinidad et al, 2005; Clarke, 1999). Other scholars have commented on Rogers' theory of diffusion of innovation pointing out some of the problems that they have found. Foster (1986) in writing about American businesses argued that businesses had difficulty changing their embedded practices when adopting innovations and was somewhat critical of Rogers theory in that it did not focus on the barriers to innovation faced by business and was success oriented . Christensen (2008) discussed the S-curve of diffusion advanced by Rogers (2003) but suggested that the initial pace of disruption of an innovation was slow, when innovation was mapped at the bottom of the S-shaped curve, but industry leaders projected a linear growth at that stage of an innovation which was misleading. Christensen (2008) stated that the transition to innovation was 'neither abrupt nor immediate' (Christensen, 2008, p. 96). Although there are some weaknesses in Rogers diffusion theory (2003), this study is not concerned with projections or predictions of growth but of describing and explaining the growth and take up of EdNA.

A comment here is necessary about the work of Frank Bass (1969) who adapted Rogers' theory of diffusion for use in marketing. Bass's theory of diffusion became widely known and was used consistently in marketing over several decades. Rogers' theory was modified in its application to technology by the work of Bass (1969) who developed the Bass Diffusion Model (Bass, 1969) to predict the take up of an innovation. The Bass Diffusion Model (Bass, 1969) explained the interaction between users and potential users of innovations, that is, the Bass Diffusion Model (Bass, 1969) was strong as a prediction model but less so in its descriptive power of large scale take up of innovation.

The Bass Diffusion Model (Bass, 1969) has been mentioned here because of its widespread acceptance and use especially in marketing products and marketing into education. The study reported in this dissertation did not use the Bass Diffusion model because this study was conducted from a descriptive/theory-building perspective, rather than a marketing/predictive perspective. For this study, with its focus on developing a case study and to describe the patterns and factors affecting

the take up of ICT in education, Rogers' theory of diffusion of innovations was a more appropriate starting point because of its descriptive strength.

The criticism that Rogers' theory is biased towards successful innovation and fails to provide a model to examine failed innovation is somewhat intrinsic to the model. Rogers calls this the pro-innovation bias. He stated:

The pro-innovation bias is the implication in the diffusion research that an innovation should be diffused and adopted by all members of a social system, that it should be diffused more rapidly, and that the innovation should be neither re-invented nor rejected. (Rogers, 2003, p. 106)

Rogers (2003) explained that re-invention along with modification was almost universal in studies of successful diffusion, especially for the sustainability of an innovation.

The positive nature of DoI theory and research is understandable because research has focussed on successful innovations. In fact, Downs and Mohr (1976) stated that 'the act of innovating is still heavily laden with positive value'. This may be explained by the fact that the first seminal study of innovation by Ryan and Gross (1943) was about the adoption of hybrid seed corn which was a highly profitable venture in Iowa. Rogers (2003) suggested that this pro-innovation bias limited diffusion research which could be richer by studying refusal and failure to adopt.

Some other criticisms of Rogers' DoI theory (Rogers, 2003) can be summarised around three issues. They are:

- the individual blame bias
- the recall problem, and
- the issue of equality. (Rogers, 2003, p. 17)

Finally, the language used to describe the categories of adopters, particularly the terms 'late majority' and 'laggards' has been criticised. Although the term 'laggard'

could be seen as 'divisive' (Trinidad et al, 2005) in educational contexts, its use does not detract from the theory as a descriptive tool.

A number of other theorists have added to Rogers' DoI theory. For example, Christensen (1997) argued that innovation strategy may lead to 'disruptive technology' or 'disruptive innovation'. Pierson (2000) articulated a concept known as 'path-dependence' which referred to the history of innovation. Pierson defines path dependence in the broader sense by stating that 'path dependence refers to the causal relevance of preceding stages in a temporal sequence' (Pierson, 2000, p. 252). Margolis and Liebowitz (2000) go further and suggest that 'path dependence' can also be seen as the tendency for institutions, such as education bodies, to maintain their structures notwithstanding disruptive technologies or technological innovation in an historical context or 'path-dependent' market failure (Margolis & Liebowitz, 2000). Discussion about disruptive technologies and path dependence are relevant when examining the barriers and success indicators of diffusion of innovation but they are not comprehensive theories of diffusion of innovation.

Being a descriptive tool, DoI theory has been very useful in this research and could be seen as a strength instead of a weakness when applied to education. Further, this research went beyond the success indicators of the development and implementation of EdNA to also include the barriers and failures in order to avoid limiting the research.

Collaboration

The idea of collaboration was structured into the very fabric of the federated national meetings that were used or initiated to guide the direction, development and management of EdNA. Indeed, as demonstrated in Chapter 2, the establishment of the national agencies responsible for EdNA (the Open Learning Technology Corporation and then Education.au Limited) were the result of federated agreements in which collaboration was enshrined into their Constitutions. Item 4 of the Constitution of Education.au Limited states:

The Company is a national collaborative education communications body which has been established to facilitate collaboration in the use of education communications and related open learning techniques throughout Australia.

(Education.au Limited, 1998a)

As can be seen below, in the *Key terms* section, the national bodies such as the Ministerial Council for Employment, Education, Training and Youth Affairs (MCEETYA), the Australian ICT in Education Committee (AICTEC), the MCEETYA ICT in Schools Taskforce (ICT T/F) and the Flexible Learning Advisory Group (FLAG) are federated bodies where the conventions of cooperation and collaboration are accepted and implied. Cooperation and collaboration are common conventions among and between federated national education committees.

However, research into the meaning and application of collaboration, its characteristics and role in large-scale ICT innovation in education was limited. The Demos study (Parker and Gallagher, 2007) suggested that 'we have barely begun to test the potential of collaboration as a design principle for public service reform'. (Parker and Gallagher, 2007, p. 14). In education this is confirmed by Nelson, Slavitt, Perkins and Hathorn (2008) who asserted that:

Although the literature on teacher collaborative inquiry is emerging, there is a paucity of both empirical and descriptive evidence on the professionals who design its structure and support teachers as they engage in this process.

(Nelson et al, 2008, p. 1270)

Other recent writings (Coleman and Levine, 2008; Schrum, 2009; Richardson, 2009) about online collaboration have focussed on the technology tools and processes that can be used to engage in a successful collaboration. The attention given to definitions of collaboration and theories for the successful application and collaboration processes were limited. However, a thorough literature review of online collaboration by Millea and Galatis (2009) does emphasise the technologies that have become available to use for engaging in online collaboration.

This study reviewed the literature to arrive at a definition and a set of characteristics to identify collaboration in education that can be applied to analyse the collaborative processes used in the initiation, development and management of EdNA. Collaboration in the literature is a relatively new research field but is important to understand because of the capacity for collaboration that ICT enables. However, in spite of this increased capacity for collaboration, very little is known about how to maximise the diffusion of large-scale ICT innovation in education (Rogers, 2003) and whether collaboration acts as a facilitator of successful adoption, a barrier to the take up of ICT in education, or possibly, has another role.

Methodology

The theory building and theory testing together with the research strength and weaknesses are discussed here.

Theory building and theory testing

The overall purpose of this research was to advance understanding of the diffusion of ICT in education, through the building and testing of a theory. The study was guided by four research questions:

1. How do theories of diffusion of innovations (i.e. Rogers, 2003) and frameworks for collaboration (e.g. Rosen, 2007; Education.au Limited, 2004a) inform the development of theory on the diffusion of ICT in education?
2. How does the application of this emerging theory to a case study of EdNA assist understanding of the critical success factors and barriers in the diffusion of ICT in education and further inform the development of the theory?
3. To what extent does collaboration appear to be a critical success factor or otherwise?

4. What are the implications of these findings for educational policy, planning and good practice?

In this study the focus for the research was on the information contained in a range of documents: archival documents, documentation from meetings, written reports, press releases, information distributions and statements about EdNA. In addition, the perceptions of key players communicated through interviews, and the recollections of the researcher who was engaged with the planning and then development of EdNA from 1995 until 2006 were included and a chronological history of EdNA was expanded throughout the research. These methods which have led to the use of a case study approach (Coleman and Briggs, 1999; Yin, 2003; Denzin and Lincoln, 2003; Crewsell, 2007) and have avoided the usual diffusion research pitfalls of surveys and interviews of individuals about innovation events which occurred quite some time in the past because the history of EdNA was relatively recent.

A case study approach was chosen as the most appropriate research method for this study because it was an empirical method of research (Coleman and Briggs, 2003) that took into account the context and history of a phenomenon of study (Yin, 2003). The questions of 'how' events happened and 'why' in research are important for a contextual understanding according to Yin (2003) and lead to the use of case studies, histories and descriptive research (Creswell, 20007). As Yin (2003) stated, 'this is because such questions deal with operational links that need to be traced over time rather than mere frequencies or incidence' (Yin, 2003, p. 6) especially about contemporary events (Yin, 2003). This research was a case study of a recent national large scale system-wide education intervention over time that was EdNA and the real-life context in which it occurred.

This research on the diffusion of ICT in education and the role of collaboration as a case study approach makes a number of assumptions and has some important limitations. There was an assumption that the use of EdNA in education was an indicator of the take up of ICT in education. This assumption was reasonable because EdNA preceded other complex ICT education services in Australia. As stated by Mason (2000), 'it was the first such database-driven website in Australia and very

much state-of-the-art' (Mason, 2000, p. 113). EdNA has continued to remain at the forefront of online education innovation and has provided services and applications that have underpinned other Australian education online services. As stated in the *EdNA hub progress report #2: January 2009* (Education.au, 2009):

In addition to edna leading innovations where it has core strengths, the edna platform will be used as a vehicle to provide greater visibility of innovative practice in learning and teaching in states and territories.

(Education.au, 2009c, 10)

As EdNA has been an innovative ICT education national service which has continued to pioneer new national education services in Australia to the present day, then this assumption continues to remain valid. In fact, EdNA has enabled its online content and services to be embedded into State education online services so that EdNA's content and services have been accessible through third party State educational services for some time (Education.au Limited, 2002f; Education.au Limited, 2004b; Education.au Limited, 2008a). This distribution of EdNA's services and content, supports the notion that the take up of EdNA reflects the educational take up of ICT innovation in Australia.

Research strengths and weaknesses

The research in this study was based on an interpretation of the information contained in the documents, the information gleaned from a number of key players and the recollections of the researcher.

This research was based on a chronological history of EdNA to which a new theory of diffusion of ICT in education has been applied. The research was therefore open to the same types of criticisms that historical research attracts: reliable evidence from reliable records and their accuracy, and a synthesis of historical reasoning. The reliability of the data and the consideration of what happened historically being more reasonable than other interpretations are issues of concern from an historical perspective.

The strength of this research was in the reliability of the original documents, the reflections of key players and the recollections of the researcher as sources of triangulated primary information, and the observations of recent events and their consequences to the diffusion of EdNA and the role of collaboration. The triangulation of the data from these three separate sources enabled the corroboration of information and events, and led to the strong reliability of the evidence and its interpretation in the study.

Significance

This research was both timely and significant for two reasons. Firstly, the quest for education to come to grips with ICT, its benefits and transformative values is ongoing and indeed gathering further momentum with the implementation of the Australian Government's Digital Education Revolution (Gillard, 2008) program of access to a computer for students in years 9 to 12. Secondly, Education.au Limited, as the governing body for EdNA, ceases operation on March 1, 2010, and merges with Curriculum Corporation into a new Ministerial agency called Education Services Australia which will focus on the national school's curriculum and so it was timely to review and analyse EdNA as an ICT innovation in education.

There is a need to understand what can be learnt from the history and experience of EdNA because the system-wide perspective is lacking from other research. Education Network Australia (EdNA) is a comprehensive Australian online education service. It was one of the major national education efforts in Australia to develop a capacity to share resources and also to enable educators to work together across geographical boundaries (Crean, 1995). EdNA, first conceived in 1994, has now been operating for over fourteen years and has become a sophisticated and globally respected web based education and training service. There is a need to understand the large scale adoption or take up of ICT in education, in Australia, including EdNA because this has not yet been done nor is there an understanding of the role that collaboration played in EdNA's adoption. The development of EdNA has taken considerable time and expense, and it has generated much interest.

Although a number of theories of ICT innovation adoption have been discussed, in the literature (Trinidad et al, 2005) such as Learning Micro Models, ICT-Oriented Models, System/School Models and Population Models, as mentioned previously, there was very little focussed on national large scale adoption by education systems. This study therefore has international significance to inform education systems about large scale diffusion of ICT innovations in education and the role that collaboration can play in the take up of ICT in education.

The research, which tested a newly developed theory of diffusion of ICT in education, focussed on large scale adoption of innovation. That is, the study was concerned with the take up of ICT in education on an education system-wide basis using EdNA as a case study. There has not been a detailed theoretical analysis of such as large scale Australian ICT innovation in education that could inform policy development and good practice.

The theory developed in this research is a much needed and timely way of thinking about and planning the implementation of ICT innovation in education to guide good practice. Detailed analysis of the take up of ICT innovation in education was also important because of the significant funding that has been allocated to it and the collaborative time, cost and effort that educational administrators, experts and educators have devoted to these types of changes in education. The new theory of the diffusion of ICT in education will be able to inform future policy direction.

Key terms

A number of terms and conventions associated with ICT and the work of national bodies have been used throughout the study. In this section the terms and conventions have been clarified and simplified, without compromising the study, so that the terminology used in this study does not detract from the research.

EdNA itself has undergone five name changes during its history and more confusingly one committee, the EdNA Reference Committee, has been generated

with the same name as a past committee. The convention adopted in this study for the naming of groups and committees, where their names have changed during the history of EdNA, was that the most recent name has been used except where a specific event in its history has been discussed.

The terms and conventions, together with the necessary history to understand the use of terms in the study, have been outlined below. They do not appear in alphabetical order but in an order based on the level of influence of each that indicates an understanding of the broad relationships among them commencing with the Commonwealth and the States.

Commonwealth Government

The Commonwealth Government (Commonwealth) is also known as the Australian Government or the Federal Government because of the Australian federal system of power sharing with the States (Australian Government, 2010). Among other responsibilities, the Commonwealth has responsibility for taxation and the distribution of funds to the States whereas the States have the constitutional responsibility for education, so cooperation is important between the Commonwealth and the States in education.

Department of Education, Employment, and Work Relations

The Department of Education, Employment and Work Relations (DEEWR) is the Commonwealth Department responsible for education as part of its portfolio. DEEWR has been formerly known as the Department of Employment, Education and Training (DEET) when the OLTC was formed in 1993, then DEET and Youth Affairs (DEETYA) in 1995, followed by DETYA in 1998 when the employment division was transferred. Then in 2001, DETYA was renamed the Department of Education, Science and Training (DEST). In 2007, it was renamed DEEWR with the election of the Rudd Labor Government (DEEWR, 2009a).

States

In Australia there are eight geographically governed regions which were colonies before 1901. They are the six States and two Territories. The six States retain the power to make their own laws in matters not controlled by the Commonwealth. The two territories are not claimed by the States and can be administered by the Commonwealth or granted self-government. For the purposes of inclusion and brevity, all eight jurisdictions have been referred to as States in this study.

Sectors of education

The three sectors of education are school education, vocational education and training, and higher education. In this study, reference has been made to the three sectors of education as schools, training and universities or higher education.

In school education there are three types of authorities that manage school education and distribute funding locally. They are government, public or State schools managed by the States; Catholic schools managed by Catholic Education and Independent schools coordinated by associations. These are referred in this study as the school education sectors in the States.

Levels of influence

There were a number of levels of influence that effected the decisions that were made for the direction, development and management of EdNA. At the highest level was the national Ministerial Council, then the national bodies that made recommendations to the Ministerial Council and finally Education.au Limited, the national education technology Ministerial company and its bodies. Each of these is explained in turn below.

MCEETYA

MCEETYA was the acronym for the Ministerial Council for Employment, Education, Training and Youth Affairs and was a national meeting of State and Commonwealth Ministers responsible for schools, training, universities and youth issues. Its forerunner, prior to 1994 was the Australian Education Council (AEC) and in 2009 it was renamed as the Ministerial Council for Education, Early Childhood Development and Youth Affairs (MCEECDYA, 2009a). The acronyms MCEETYA and MCEECDYA have been used where appropriate.

AICTEC

AICTEC, the Australian ICT in Education Committee, was first known as the EdNA Network Business Requirements Reference Group in 1995 and then the EdNA Reference Committee (ERC) which was established in 1996. It was then renamed as AICTEC in 2001. AICTEC is a national meeting of senior State officials from school education and training, with university representatives, the Commonwealth and a representative from Education.au Limited and a number of observers. In 2009, AICTEC stated its role in the following way.

AICTEC has been asked to provide strategic policy advice to COAG [Council of Australian Governments], MCEETYA and DEEWR regarding *Digital Education Revolution* implementation and related ICT issues. In particular, AICTEC has been asked to provide advice on cross sectoral issues so that investments in the *Digital Education Revolution* can benefit education as a whole and on strategies to integrate investments in ICT with wider educational objectives. (AICTEC, 2008)

AICTEC has had a number of sub-committees since its inception and has maintained oversight of EdNA since it began. The consultative sub-committees for each education sector have included a national schools group, a vocational education and training group, and a number of higher education groups. Each group is described in turn below.

MCEETYA ICT Schools Taskforce

The MCEETYA Schools ICT Taskforce (ICT T/F) began in 1996 as the EdNA Schools Advisory Group (SAG), a sub-committee of the former EdNA Reference Committee. Essentially, ICT T/F was the schools consultative group for the EdNA project and reported to the EdNA Reference Committee, now named AICTEC. Each member of the ICT T/F brought its State's needs to the meetings and reported back at the State level. The management of ICT T/F was supported by a project officer from 1997 until 2007 when the MCEETYA Schools ICT Taskforce was disbanded.

EVAG/FLAG

The Flexible Learning Advisory Group (FLAG) began in 1996 as the EdNA VET Advisory Group (EVAG), and reported to the former EdNA Reference Committee on vocational education and training (VET) needs and issues. Essentially, EVAG was the training sector's consultative group for the EdNA project. Each member of EVAG brought the State's needs to the meetings and reported back at the State level. EVAG was renamed the Flexible Learning Advisory Group (FLAG) in 2000 when the Australian National Training Authority (ANTA), with agreed funding from the training sectors in the States, was directed by the Australian training Ministers:

to develop a framework strategy to provide the e-learning infrastructure and expertise to respond to the business and skilling demands for training in a digital economy. (EdNA VET Advisory Group, 2000, p. 1)

The management of EVAG was supported by an EdNA project officer until the year 2000, when a Secretariat for the Australian Flexible Learning Framework (AFLF) was formed.

HEAG

The Higher Education Advisory Group (HEAG) was initiated by the Commonwealth in 1998 for the purpose of consultation about EdNA issues with universities. After four meetings the group lapsed into disuse in 1999. However, project officers did continue the work of HEAG by managing projects related to EdNA on behalf of the university sector. The university sector also maintained the role of nominating university selected representatives to AICTEC from the inception of EdNA in 1995.

OLTC

The Open Learning Technology Corporation (OLTC) was initiated in 1993 at a meeting of the Australian Ministers of education, operating as the Australian Education Council (AEC). OLTC was established for the purpose of promoting open learning technologies, developing networks of expertise across the States and to provide a research brokerage (Hesketh, 1996). OLTC was re-energised with the new purpose of managing EdNA in 1996 (Gibbons, 1995a), reformed in 1997 and then renamed as Education.au Limited in February, 1998 (Education.au, 1998a). In June 2009, MCEECDYA made the decision to merge Education.au and Curriculum Corporation (Education.au Limited, 2009a) and then in December, 2009, MCEECDYA announced the purpose and role of the new body to be known as Education Services Australia (MCEECDYA, 2009b). EdNA was not mentioned in the role for the new national education company (MCEECDYA, 2009b).

Education.au Limited

Education.au Limited, established in 1998, was the national education technology agency limited by guarantee and owned by the Ministers of education for schools, training and universities as well as the Commonwealth. The objects of Education.au Limited stated in its constitution were to:

- promote cost effective, high quality and equitable uses of education communications and related open learning techniques among Education Bodies and, in connection therewith, provide governance to EdNA;
- conduct surveys and research on behalf of, and under the instruction of, Education Bodies relating to the evaluation of education communications and related open learning techniques for the purpose of improving teaching and learning processes throughout Australia;
- prepare tender documentation on behalf of, and under the instruction of, Education Bodies and, if requested, execute any successful tenders in accordance with the instructions of such Education Bodies;
- conduct feasibility studies on behalf of, and under the instruction of, Education Bodies;
- facilitate the cooperation and collaboration of Education Bodies in the use of education communications and related open learning techniques throughout Australia;
- foster the cooperation and collaboration of Education Bodies and key educational stakeholders for the purpose of developing and using the Internet as a tool for the delivery of education and training services throughout Australia;
- carry out such other tasks or activities on behalf of, and under the instruction of, Education Bodies on such terms and conditions as shall be mutually agreed upon between the Company and such Education Bodies; and
- carry out all other tasks or activities which are necessary or incidental to the achievement of any of the objects of the Company.

(Education.au Limited, 1998a, p. 1-2)

Education.au Limited preferred to refer to itself in the bold and italicised form of ***education.au limited*** which was a registered trade mark. However, in this study presented in print, the form Education.au Limited has been used for formal references although the Limited has often been omitted for the sake of brevity and readability.

Education.au Board

The Education.au Board was charged, by the Constitution of Education.au Limited, with the responsibility for managing the business of the company and also for providing the governance of EdNA (Education.au, 1998a). The Board comprised a member from each of the sectors of education (three persons) and one from non-government schools together with three experts, a nominee from the Commonwealth and a Chairperson appointed by the Commonwealth. From time to time, the Board employed consultants to join the Board for specific purposes such as to provide feedback on the achievements of the Board's goals and to review the performance of the Chief Executive Officer (CEO). The Education.au Board was owned by and reported to MCEETYA.

ERC

The EdNA Reference Committee (ERC), not to be confused with AICTEC, was a national consultative group comprising members from the three sectors of education and one from non-government schools together with two experts, a staff member from Education.au and a Chairperson nominated by Education.au. The ERC reported to the Education.au Board and was responsible for advising Education.au on the directions for the development and management of EdNA.

The ERC began in 1997 as an operational meeting, then called EdNA Project Manager's meeting followed by the EdNA Development Workshop (EDW), between Education.au managers of EdNA and project managers from the schools, training and university advisory groups together with the Commonwealth. ERC met as a loosely formed operational meeting of EdNA project leaders until 2001, when it became a committee reporting to the Board of Education.au called the EdNA Online Reference Committee (EORC). In 2007 the 'Online' was dropped from the title of the committee to become the ERC. The ERC was managed by Education.au Limited.

ICT

ICT is an acronym for information and communications technology/technologies.

WWW

WWW is the common acronym for the World Wide Web.

EdNA

EdNA has undergone a number of name changes throughout its fourteen year history. In fact, when it was agreed by Ministers in May, 1995, it was referred to as the Australian Education Network (AEN). However, the name 'AEN' had already been used elsewhere as an Internet domain name which meant that another name and acronym had to be chosen, and that was EdNA. In 1995, the term EdNA referred to the cooperation between the States, the three sectors of education and the three sectors of school education together with the Commonwealth. EdNA was described as collaboration. In order to distinguish EdNA as a group of professional educational leaders engaged in collaboration from EdNA's web presence, the website was launched as EdNA Online. Then in 2001, the web service was simplified to the shorter EdNA and in 2005, EdNA was renamed as the lower case 'edna' followed by the italicised style *edna*. Finally, in 2007 the managers of EdNA expressed a preference for the full web address 'edna.edu.au' citation where possible. These changes are discussed in more detail in Chapter 2. This study has used the term EdNA throughout for the purposes of simplicity, brevity and readership.

Overview of the thesis

Following this introductory chapter, this dissertation provides, in Chapter 2, a chronological history of EdNA focussing on the initiation, establishment and diffusion or take up of EdNA in education and the collaborative processes that were undertaken to develop EdNA. Chapter 3 then presents a literature review of the diffusion of innovation and collaboration, where the term 'collaboration' was defined

for use in this study. These lead to a proposition for the diffusion of ICT in education that involves EdNA's antecedents, its adoption and the role of collaboration in the take up of EdNA. Chapter 4 describes the methodology that was undertaken to test the theory of the diffusion of ICT in education and the role of collaboration, using EdNA as the case study. Chapter 5 tests the theory through the likelihood of the success of EdNA by researching the attributes of innovation as the antecedents of EdNA. Then in Chapter 6, the statistical take up or adoption of EdNA was tested for consistency with diffusion of innovation theory and the peak periods of usage are identified. Chapter 7 tests the theory developed in this study by examining the role of collaboration and its characteristics in the take up of EdNA, including an analysis of what can be learnt from an examination of the peak periods of EdNA's usage and of EdNA's services that were not successful. Finally, in Chapter 8 a detailed discussion of the findings from testing the theory of the diffusion of ICT in education proposed in this research was presented, together with recommendations for good practice in the diffusion of large scale ICT initiatives in education, as well as some suggestions for further research.

Chapter 2 Development of EdNA

Purpose and Outline of this Chapter

The purpose of this chapter is to present an historical account of the development of EdNA, thus providing the background to the chronological history undertaken in this research.

As indicated in Chapter 1, in 1995, Education Network Australia (EdNA) was initiated and over the following years developed, launched and expanded, with modifications, to become a national Australian portal and collaborative service, acknowledged internationally (Bosco, 2006). As also indicated in Chapter 1, no coherent chronology of EdNA's establishment existed prior to this present study. Thus, this historical account of EdNA is one of the major outcomes and original contributions of this research.

This chapter focusses on the period from 1991 to 2008. The first part of the chapter introduces the major trends that influenced the establishment and then development of EdNA. It includes a brief summary of related activities globally. This is then followed by an historical analysis of the Australian political landscape that led to the establishment of EdNA, its leadership, operation and launch in 1997. Then the remaining part of the chapter is an account of the growth of EdNA, the emergence of online communities using EdNA, interactive collaboration on EdNA and finally, its personalisation services. Some selected statistics are included in this chapter in order to graphically depict the rapid growth and take up of EdNA as a forerunner to the detail of EdNA's adoption in Chapter 6.

The environment

In order to understand the role that EdNA played in the diffusion of ICT in education, it is also necessary to understand the context of the Internet from 1989

until the present and the educational policy making landscape in which it was developed. In Australia and many Western nations, the use of ICT in education during the period 1989 to 2008 was characterised by a number of trends and influences. Five of these are reviewed here because of their relevance to this research.

The key trends and influences were:

- the priority given to ICT in education in 1989,
- the development of the world wide web (WWW) in 1989,
- an increasing provision of computers in education (and the identification of the need for Internet access and bandwidth) in 1995,
- the formation of OLTC to encourage the use of ICT in education and training in 1993 and the creation of a Commonwealth national ICT lead agency, OLTC (then Education.au Limited), to manage EdNA in 1997, and
- the emergence in 2001 of the web from a static ‘read-only’ mode to a dynamic ‘read/write’ interactive mode.

The following sections outline each of these trends in turn.

ICT as a priority

By 1989 in Australia, the relevance of computers in education was accepted by educational administrators and some teacher groups although for schools the high costs of computers, Internet access and support were seen as major constraints. Anderson (1984) alludes to a number of major reports commissioned by the Commonwealth Schools Commission and concludes that,

The promise of microcomputers for schools, according to some is very great. The availability of microcomputers in the classroom, it is asserted, will individualize instruction, improve basic literacy and numeracy skills, motivate reluctant students, and help those with special needs. (Anderson, 1984, p. 2)

Throughout the 1980s, there was an emerging recognition by national education leaders that computers were being used spasmodically in education, that the impact of their use was scant and that the costs of provision were unknown (Meredyth, Russell, Blackwood, Thomas and Wise, 1999; Sheers and Dale, 1983; Commonwealth Schools Commission, 1983).

Gradually, in the 1990s the imperative for the educational uses of computers became a priority with senior education leaders, especially in schools and school systems. Indeed, the sixth goal of the 1989 Common and Agreed National Goals for Schooling in Australia (MCEECDYA, 2009c) included the aim:

To develop in students:

- d. skills of information processing and computing.

(MCEECDYA, 2009c)

In higher education the Commonwealth Government:

had taken a lead in investigating, reviewing, and encouraging the adoption of and integration of communications technology into the delivery of education programs. (Hesketh et al, 1996, p. 5)

A range of national reports and policy initiatives emerged between 1991 and 1996 that were focussed on computer based education, cost effectiveness and the convergence of technologies. Some of these included Telecentres in rural communities, Community-based Information Technology Centres, piloting of a Community Information Network, the establishment of the OLTC in 1993 and the establishment of the Information Services Council in 1995 followed by the beginnings of the idea for EdNA. These and other initiatives led to the notion of shared resources which was one of the elements that drove the formation of EdNA. However, in practice at this time, desktop computers were used as standalone workstations, only in some circumstances connected to local networks, in schools, colleges, universities or school systems.

The World Wide Web

What proved to be a breakthrough in the use of networking computers in education came in March 1989, when Tim Berners-Lee and co-creator Robert Cailliau at CERN in Switzerland wrote their famous proposal which led to the development of the World Wide Web. The *Information Management: A proposal* (Gillies & Cailliau, 2000, p. 181) paper was received as a ‘vague but exciting’ (Gillies & Cailliau, 2000, p. 181) idea by CERN management’s Mike Sendall. However, this new web service using the Internet spread rapidly, especially in the Western world because it enabled networking graphics and text much simpler than previously. The use of graphics to render web pages meant that finding information was so much easier using a browser such as Mosaic released in 1993 (Gillies and Cailliau, 2000, p. 233) and so web based systems entered the discussion about shared resources in education.

Computers in education

As stated earlier, by 1993 Australian educational leaders were moving more actively to meet the challenge of providing computers in education. In addition, professional teacher associations known as computer education groups had formed in every Australian state and a national coordinating body called the Australian Council for Computers in Education had become very active. The first national conference of educators concerned about the use of computers in education was held in 1983, under the auspices of the Computer Education Group of Victoria (Anderson, 1984).

National education technology agency

Also in 1993, MCEETYA established the Open Learning Technology Corporation (OLTC) as a company owned by the Australian Ministers of Education and Training. OLTC’s role was ‘to encourage and support high quality, cost effective open learning on a national basis, providing a focal point for collaborative activities and general promotion’ (Hesketh et al 1996, pp 4-5). Then in 1995, MCEETYA agreed that OLTC would be restructured to become the ‘governing body of EdNA’ (MCEETYA,

1995a). By 1996, however, the Commonwealth government appeared to have recognised the need to repurpose as well as restructure the OLTC ‘as a matter of urgency’ for:

fostering collaboration and cooperation between key stakeholders in the use of Internet as a tool for delivery of education in Australia.

(MCEETYA, 1996a; MCEETYA, 1996b)

Thus, in 1997, the OLTC was repurposed as a national collaborative technology agency – renamed Education.au Limited in 1998 - to take forward the agenda of the Internet in education and to specifically manage EdNA, for all sectors of education – higher education, vocational education and training, and schools (both government and non-government).

Interactive WWW

By 2001, the Internet had changed from an information static presence or 'read-only' web to one where both information and interactive communications or a 'read-write' web emerged. The 'read-write' media enabled interactive publishing and interactive digital communications by groups of people. The notion of the 'read-write' web was popularised in 2004 in an ebook by Dan Gillmor, *We the Media - Grassroots Journalism by the People, for the People* (Gillmor, 2004) in which he stated:

Berners-Lee envisioned a read/write Web. But what had emerged in the 1990s was essentially a read-only Web on which you needed an account with an ISP (Internet service provider) to host your web site, special tools, and/or HTML expertise to create a decent site. (Gillmor, 2004)

Gillmor continued:

What Winer³ and the early blog pioneers had created was a breakthrough. They said the Web needed to be writeable, not just readable, and they were determined to make doing so dead simple.

Thus, the read/write Web was truly born again. We could all write, not just read, in ways never before possible. For the first time in history, at least in the developed world, anyone with a computer and Internet connection could own a press. Just about anyone could make the news. (Gillmour, 2004, p. 2)

In 2004, the idea of both reading and writing on the web through services such as wikis and web-logs or blogs, as they have become known, was relatively new to education. However, educators were attracted to blogs and their use was increasing in education. A number of services, specifically dedicated to education, were being made available for teachers using such web based tools as blogs, wikis and forums. This new platform for interactively communicating and publishing gave a new direction for EdNA which extended its communication and micro-publishing services for teachers.

A note on the global response to the key trends and influences

Almost at the same time in Europe, the European Commission was considering similar issues associated with the use of multimedia in education. In December 1996, the Swedish Minister for School and Adult Education, Mrs Ylva Johansson, presented a proposal to establish an 'European electronic network of schools' through a body to be known as the European Schoolnet (European Schoolnet, 2004). Following ratification by European Ministers of Education early in 1997, the new European body called Schoolnet was established originally in Stockholm and then in

³ In mid-1999, David Winer was the founder of a pioneering weblog company called UserLand Software in Los Angeles. For further information go to http://en.wikipedia.org/wiki/UserLand_Software

1998 in Brussels within proximity of the European Commission with which there was a close liaison.

In the UK, a number of programs focussed on the use of computers in education took place in the late 1970s and early 1980s. Programs such as the Microelectronics Education Programme (MEP) in 1981 funded for £12 million by the national government and the British Broadcasting Corporation (BBC) Literacy Project in 1982 (Millwood, 2009) were major national educational programs investigating the beneficial uses of microcomputers in education. Then in 1998, the newly elected Government in the UK announced the National Grid for Learning (NGfL) (British Education and Communications Technology agency, 2002) to cover the whole of the UK. In 2001, the funding for the NGfL was £245 million over two years (Department for Education and Employment, 2001).

In the USA, CoSN was initiated in 1992 as a professional association for school district technology leaders (Consortium of School Networking, 2009). However, ISTE which began in 1979 pre-dated CoSN. Both of these initiatives harnessed education ICT leaders and users respectively to share their experiences in the uses of computers in education. The national US Department of Education encouraged education in each state to develop their own online initiatives through its Office of Educational Technology established in 1995 (Roberts, 1996). One of the earliest initiatives in the USA was the Minnesota Educational Computer Consortium (MECC), followed by similar efforts in Santa Clara and Cupertino Valley (Anderson, 1984, p 17-24). These consortia were well placed in education when the WWW became global in the early 1990s. However, even in 2010, the USA did not have a national education online service.

Canada SchoolNet which began in 1993 (Mappin, 1995), was arguably one of the most successful WWW connected national education initiatives in the world. This school based national initiative managed and funded for \$1.6 billion over four years by Industry Canada had the role of connecting Canada's schools to the Internet as well as managing a number of national online education projects (Mappin, 1995). In 2004 Canada SchoolNet had coordinated the:

connection of Canada's 15,300 schools including 480 First Nations schools and 3,400 libraries as well as distribute over 450,000 refurbished computers to schools and libraries. (Industry Canada, 2004, p. iv)

The National Policy Context of the development of EdNA

The five trends and influences outlined above – namely, acceptance of computing as an educational priority, the development of the WWW, the provision of computers in education, the re-purposing of OLTC to manage national Internet services and the emergence of the read/write web – combined with the international movements in the use of ICT in education, contributed to the mounting momentum for the development and growth of EdNA. The national policy context, however, also contributed significantly to this momentum.

The national policy landscape in the 1990s included the establishment of the OLTC in 1993, mentioned earlier in this chapter, by the Australian Education Council (AEC) which was a meeting of Commonwealth and State Ministers of education. The role of the OLTC was to support information networking and resource sharing in education by providing a brokerage for and leadership of technology projects as well as a library clearinghouse for research and reports on the use of information technology in education. As indicated in White (2003), the landscape also included the publication of three important documents stimulated by the Prime Minister's Science, Engineering and Innovation Council. The first was a report by the Australian Science and Technology Council titled *The Networked Nation* (Commonwealth of Australia, 1994a) in response to a Senate request from Senator Peter Cook, Minister for Industrial Relations, for information about the benefits of research data networks for universities, government and education. The second was a national policy statement titled *Creative Nation* (Commonwealth of Australia, 1994b) which stated:

The convergence of communications and information technologies allows us a "gateway" to the rest of the world. (Commonwealth of Australia, 1994b, p. 6)

Both documents argued for the convergence of communications and media urging the then Minister for Employment, Education and Training, Simon Crean MP, to establish an information network for science and education. The third report, *Networking Australia's Future: Final Report* (Australian Government, 1994) from the Broadband Services Expert Group went further and resulted in the National Strategy for New Communications Networks and was announced by the Commonwealth Government in April, 1995. Further, this report specifically recommended that:

We must explore the potential contribution of new features and services such as interactivity, multimedia applications, and networked information discovery to optimizing educational outcomes for each sector. We need to assess the possibilities they offer for self-directed learning on one hand and collaborative learning on the other. ...teaching and learning styles and roles that emerge from the introduction of new services should be articulated: they will probably be different from current practice. (Australian Government, 1994, p. 38)

In fact, the *Networking Australia's Future: Final Report* (Australian Government, 1994) argued that the development of network services in education was essential.

There were also numerous other reports sponsored or undertaken by the Commonwealth Government around this time. These reports focussed on higher education, the types of technologies being used and their applications in education, the convergence of technologies and providing directions for change in education (Hesketh, 1996) giving further impetus to the need for a strong higher education participation in developing sophisticated education network services.

On 6 April, 1995, a press statement from the Hon. Simon Crean announced that the Australian Federal Government had approved the establishment of the Australian Education Network (AEN) to put education and training on the information superhighway (Crean, 1995). The statement went on to say that:

The first phase of the network, which will start this year, will develop a directory of educational services and an interactive electronic message system that can be

accessed at affordable rates by students and teachers from education institutions and the home, regardless of location. (Crean, 1995, p. 1)

This statement signalled the beginning of EdNA (announced as the Australian Education Network) as an information service, by the Commonwealth of Australia. There were other motives too for establishing an Australian education network that were mentioned in the press release. Such benefits included affordable tariffs for network users, a publishing platform for Australian education, software development and distance and open learning techniques, national collaboration of curriculum frameworks and a culture of innovation in the production and distribution of educational material mainly for domestic use with spin-offs for export markets (Crean, 1995). Also, still uppermost in the mind of the Commonwealth Government, was the combined purchasing power or 'leverage' (Crean, 1995) of education to provide computers in order to access the network. The Minister, Mr Simon Crean MP, also announced that:

consultations with States and territories and the education community will begin immediately to develop a national collaborative approach to network development. (Crean, 1995, p. 1)

On the 26 May, 1995, at the third MCEETYA meeting, Ministerial agreement for an Australian network was reached by the Ministerial Council of Education, Employment, Training and Youth Affairs (MCEETYA, 1995a). MCEETYA agreed to set up processes for determining the content needs, network services and reception infrastructure details by the 8 December 1995. The effort was to be called Education Network Australia and abbreviated as EdNA.

Then in July 1995, a national consultative committee known as the Reception Infrastructure Committee was formed to support facilities for teachers and students to access the Internet and also EdNA (DEET, 1995a). The Reception Infrastructure Working Party (comprising members of the three major education sectors – schools, vocational education and training, and higher education) was formed by the Commonwealth Government to 'leverage' the advantages of bulk computer purchasing. On 25 June, 1996, the results of the tender were announced in the press

for a nationally agreed computer specification and a list of complying computer brands and models which could be used for connecting to the Internet and the WWW (*The Australian*, 1996). This effort was concentrated on the purchase of computer equipment and accessories. The notion of working nationally as an education collective so that bulk purchases brought pressure on the market to reduce the purchase prices of computers for education was attractive to education authorities. The agreement by national and State governments on the purchase of computers demonstrated that the Commonwealth and States could agree at Ministerial and senior bureaucratic levels on technology issues of common concern and interest in education.

The fourth meeting of MCEETYA on 8 December, 1995, began the task of putting in place some of the building blocks to establish the information service. The *Information Statement* from the meeting reported that:

Ministers endorsed the expansion of the charter of the Open Learning Technology Corporation (OLTC) and the restructure of the Board to enable the OLTC to become the governing body of EdNA, gave in principle approval to the proposed cash flow required for establishment costs of EdNA in its first three years of operation and noted development of a network business requirement and of specifications for a combined tender for the purchase of reception infrastructure.

(MCEETYA, 1995b, p. 1)

This agreement meant that the combined States and Territories had now agreed to collaborate with the Commonwealth Government to achieve the establishment of the information network. The processes for undertaking those collaborative discussions were outlined in a speech by Mr Wayne Gibbons, Deputy Secretary, DEETYA, to the Australian Information Industry Association (AIIA) on 19 June, 1995. It foreshadowed that the consultations for EdNA would be undertaken by a small expert working group whose task would be to consider participation in the network and the issues that would need to be addressed (Gibbons, 1995a). In addition, the full definition of the business requirements for a national education network were to be the focus of a reference group with representatives from all education sectors and all States and Territories (Gibbons, 1995a). As discussed in more detail in the next

section of this chapter, the intended role of the reference group was to certify that the description of the network business requirement developed by the Commonwealth properly reflected the needs of State education systems.

The final chapter in the establishment and governance of EdNA was the decision by education Ministers at the 5th MCEETYA meeting on the 17 and 18 July, 1996, in Brisbane, to capitalise on making best use of the Internet. The report of the meeting stated:

Ministers noted that the focus of EdNA has shifted from development of a network to the fostering of collaboration and cooperation between key stakeholders in the use of the Internet as a tool for delivery of education in Australia. Because the current administrative structure does not reflect this change in focus, Ministers agreed that the Board of the Open Learning Technology Centre (OLTC) be restructured as a matter of urgency. Ministers also agreed that an EdNA Reference Committee be established and report to the restructured OLTC. This committee will provide advice to Ministers on major policy issues associated with the use of the computer networks in the delivery of education and to the Board on the strategic directions for the development of EdNA and on implementation and governance issues.

(MCEETYA, 1996b, p. 2)

The restructure of OLTC to be responsible for the governance of EdNA was finalised in December, 1996, and the new OLTC was ready to begin operations in 1997. In February, 1998, OLTC was renamed Education.au Limited and was registered as a MCEETYA-owned company, limited by guarantee.

A sum of over \$635,000 was allocated by the Commonwealth to the ongoing maintenance and upgrading of EdNA in 1996. When MCEETYA agreed to establish the national agency in late 1996, the States also agreed that they would collectively contribute annually to the funding of EdNA⁴ on a pro-rata population basis. This effectively doubled the funding to \$1.27m available annually for EdNA and the

⁴ The aggregated contribution of the states was an amount equal to that paid by DEEWR. The contribution from each state was based on a per capita formula from the Australian Council for Educational Research.

management of Education.au Limited. In 1998, the funding for the governance and management of EdNA was raised by MCEETYA to \$1.58m and the management of EdNA was moved from DEEWR to Education.au Limited. The collaborative funding by the Commonwealth and State Governments has continued to this day.

As pointed out by Dellit (1998), the development of EdNA was timely for a number of reasons. It enabled State education authorities, referred to in Commonwealth documents as stakeholders, together with the Commonwealth government, to cooperate in a number of ways. For example, they were able to think through, collectively, new education policy issues arising from the emerging digital technologies, to utilise common resources and ideas, and to learn from one another especially as the WWW had begun to impact in Australia (Dellit, 1998). Further, they could address, collectively, concerns raised about protecting young people from undesirable content and persons using the Internet while at the same time encouraging responsible, effective, high quality educational resources and use (Mason, 2000).

In summary, EdNA was a cross sectoral online service designed for use in school education, training and university education. Further, EdNA was designed as a collaborative national effort, in the hope that the participating stakeholders, as a collective, would avoid duplication of effort and gain more than if they operated separately. The idea of adding value to online educational resources through accessing, sharing and developing further networked linkages was uppermost (Mason, 2000) in the minds of the stakeholders. However, there also remained a strong fear that sectors of education which were already making use of computers in education had the potential to form islands of non-connectivity and duplication (Gibbons, 1995a). In practice, as explained in the next section, an operational framework for the leadership and management of EdNA was designed to avoid this outcome.

Operational Framework for Leadership and Management of EdNA

As indicated earlier, a national collaborative EdNA Network Business Requirements Reference Group was set up in 1995. Subsequently, in 1996, this was renamed the EdNA Reference Committee (ERC) by MCEETYA to take up an expanded role encompassing advice to Ministers as well as advising on the implementation of EdNA. For many years, the ERC remained fundamental to the effective leadership and management of EdNA. It continued to be led by the Commonwealth and it continued to guide the overarching development of EdNA's business requirements. Consistent with a collaborative model of operations, ERC was supported by three advisory Taskforces established by MCEETYA in December, 1996, as part of the Constitution of the restructured OLTC (MCEETYA, 1997a). An EdNA Advisory Group was established in each of the three education sectors: schools; training and higher education. They were called the EdNA Schools Advisory Group (SAG), the EdNA VET Advisory Group (EVAG) and the Higher Education Advisory Group (HEAG). These sectoral groups provided a grounding influence on the development of EdNA through their direct consultations within their respective sectors.

One of the major and lasting efforts of the ERC that guided the development of the collaborative EdNA was the set of principles for inclusion of content on the online service. These principles, known as content standards, agreed in 1996, (EdNA Schools Advisory Group, 1997) were a major element in laying the foundation for the nationally agreed understanding of collaboration between national and State governments, and the education sectors even though they were conceived to guide content inclusion. The twelve principles included the following small selection which is key to this research:

- Australian perspective
edna serves Australian education. Its organisation, services and standards will reflect this Australian perspective. **edna** will actively seek and promote Australian content that meets the standards.
- Collaboration

The principle of collaboration was determined by MCEETYA in 1996 and constitutes a formal policy for **edna**. Collaboration occurs in a range of specific forums as well as through broader consultation.

- **Comprehensiveness**
The services and links on **edna** aim to be sufficiently comprehensive to cater for the full range of Australian education and training.
- **Networking**
edna is a social networked service and it therefore develops and uses tools and administrative processes that support networking. This requires distributed or decentralised processes within a documented framework.
- **National benefit**
edna is a national network of the education community in Australia and is resourced and supported by all Australian governments. **edna** therefore provides a publicity channel for educational material of national significance. It will be more than the sum of its parts as it seeks to leverage products and services for national benefit.
- **Public domain**
edna is publicly funded and will operate in the public domain. (EdNA, 1997)

These principles, developed over a period of years, became the overarching framework for EdNA for the next decade. The principles were also fundamental to the operations of Education.au as the national agency managing EdNA.

In framing a constitution for Education.au, the education stakeholders of the ERC emphasised the importance of collaboration as the purpose of the agency and its required method of operating. A part of the Constitution, the Memorandum of Association, Item 4, for Education.au Limited stated:

The Company is a national collaborative education communications body which has been established to facilitate collaboration in the use of education communications and related open learning techniques throughout Australia.

(Education.au Limited, 1998a, p. 1)

The Memorandum goes further in listing the objects of the company. Two objects of the company from its Constitution merit restating here.

The objects for which the Company is established are to:

- 5.1 promote cost effective, high quality and equitable uses of education communications and related open learning techniques among Education Bodies and, in connection therewith, provide governance to EdNA; and
- 5.5 facilitate the cooperation and collaboration of Education Bodies in the use of education communications and related open learning techniques throughout Australia. (Education.au Limited, 1998a, p. 1)

The intention of MCEETYA was unambiguous in stating that the national agency would manage EdNA and do so collaboratively with the Commonwealth and State Governments and their departments of education and training. EdNA as an Internet service with servers, Internet connections and a directory was developed in a number of stages, the first of which was the physical acquisition of the equipment by the Commonwealth Government. The next section of this chapter focuses on the technical dimensions of EdNA's history, and their association with the development and growth of the network.

EdNA in Operation

The technical establishment of the online EdNA service by the Commonwealth went through a number of phases from EdNA's inception, consultation and collaboration with the States, to its launch in November, 1997. The launch of EdNA was followed by a intense period in which online communities proliferated and were encouraged by Education.au Limited. The following account traces the progress of EdNA under six headings:

- Initiation,
- Collaboration
- EdNA launch and growth
- Establishing online communities
- Interactive collaboration
- Personalisation.

Initiation

Although the decision to develop an Australian education network was taken by the Commonwealth Government in 1995, the technical website development of EdNA did not begin until 1996 after the acquisition of the equipment and configuration of the software. These technical developments were undertaken by a private contractor, who was supervised by an internal Commonwealth departmental team, the EdNA Networking Taskforce, responsible for the national supervision of the EdNA Project. OLTC, at that time, was responsible for the consulting with the stakeholders about the strategic direction of EdNA, the directory structure and implementation issues.

In the early stages of the ERC, the term EdNA referred to the national education collaboration whereas the online service was differentiated by being called EdNA Online. However, that distinction eventually lost its meaning and, by late 1998, the short title EdNA became the generalised acronym for the whole project and will be used in this sense throughout this chapter. EdNA was the first database-driven educational website in Australia, built around the concept of a browsable and searchable directory of online resources (Putland, 2003). One of the first collaborative tasks of the ERC and its advisory groups was to nationally agree on the directory of information categories for each of the three education sectors so that an online directory service could be built.

The ongoing work to agree the education information categories came from a view that access to the stored information would be by browsing the hierarchical categories of information in the relevant (schools, training, university) education sector. Within a year, browsing appeared to be insufficient and a search function was developed for the EdNA Directory Service (Mason, 2000). As noted by Mason (2000), the development of search functions, such as a 'simple' search and an 'advanced' search, led to the realisation that metadata, that is, standardised keywords in a purposeful structure, would be needed to retrieve digital resources easily. The EdNA Schools Advisory Group at its first meeting on August, 23, 1996, developed guidelines for EdNA about content standards for schools, gathering and managing

content, publishing standards, directory services and quality assurance that included metadata (EdNA Schools Advisory Group, 1996). During this initial development period of EdNA, it was important to ensure the interoperability of the EdNA services with those online services being developed by States in order to exchange data and information. In time, this work was expanded to include the requirements of the training and higher education sectors resulting in the EdNA Metadata Standard (Millea, 2003) based on the internationally accepted Dublin Core Metadata initiative. The draft version 0.3 EdNA Metadata Standard was adopted by the Commonwealth Government in 1997 and the version 1.0 approved by ERC in 1998 (Mason & Ip, 1998). The EdNA Metadata Standard had been developed as a minimalist set of elements to ensure interoperability with other networked systems. As stated by Millea (2003):

The goal of the EdNA Metadata Standard from an organisation point of view was firstly, to provide a consistent, flexible and extensible structure for the description of online resources related to education and training, and secondly, to provide a platform for interoperability with the state and territory education systems.

(Millea, 2003, p. 5)

As acknowledged in Millea (2003) metadata became an essential tool for efficiently finding online resources using search functions. As intended, it also enabled the EdNA service to become interoperable with State online services. In 1997, the Commonwealth Department of Employment, Education, Training and Youth Affairs (DEETYA) became a member of the IMS Global Learning Consortium (then known as the Instructional Management Systems Project), a global body developing online standards, including metadata, for educational Internet services. The Australian metadata and technical efforts were maintained and strengthened through engagement in the global IMS forum, which led to alliances with other standards bodies. The engagement with the IMS Project helped to keep EdNA services technically up to date as well as to provide technical interoperability protocols for national and State online services. The experience of developing an Australian metadata set, such as the EdNA Metadata, from the ground up was a complex task and proved to be time consuming, starting in 1995 and finally being approved by the EdNA Reference Committee in 2000 (Millea, 2003). However, the pursuit of

globally accepted technical standards and their adaptation to the local context and adoption in Australian education and training enabled efficient linking and sharing of resources as well as development of wide ranging services for online professional education communities.

Collaboration

The issue of collaboration is part of this chronological history of EdNA because the structures that were established for EdNA and also for Education.au specifically mentioned cooperation and collaboration. In fact, MCEETYA (2009) as the national council that agreed to EdNA being a national system for sharing educational resources stated that the:

Functions of the Council include coordination of strategic policy at the national level, negotiation and development of national agreements on shared objectives and interests (including principles for Australian Government/State relations) in the Council's areas of responsibility, negotiations on scope and format of national reporting on areas of responsibility, sharing of information and collaborative use of resources towards agreed objectives and priorities, and coordination of communication with, and collaboration between, related national structures.

(MCEETYA, 2009, p. 1)

Similarly, the Constitution of Education.au (1998a) was quite specific about how the national agency should undertake its responsibilities. Twice in the objects of the Constitution there was use of the phrase 'cooperation and collaboration' in relation to working with Education Bodies. The agency was required to foster and facilitate cooperation and collaboration with Education Bodies in the use of education communications and the Internet. In addition, the Constitution mandated that Education.au initiate collaborative activities in maintaining its relationships with education departments throughout Australia when it stated that the agency would facilitate:

the efficient fostering and initiation of collaborative developments associated with education communications and related open learning techniques.

Collaboration was fundamental to the purposes of the agency in its governance of EdNA as the way that it was to initiate and undertake its activities as well as maintain links and working relationships with State and Commonwealth education departments.

Both MCEETYA and Education.au's governing Board were formed through the appointment of sector and State representatives although representation was not necessarily collaboration. However, in the documents the words networking, coordination, cooperation and collaboration were all included. The question then becomes, one concerning the distinction between each of the four ways of operating. In order to begin to understand this, a close examination was necessary of the way that EdNA evolved and the groups that were engaged in the process.

As foreshadowed earlier in this chapter, the ERC played a central role in the development of EdNA. Each step in developing the EdNA service was summarised and considered by the EdNA Schools Advisory Group (SAG), the EdNA Vocational Education Training Advisory Group (EVAG) both of which reported to the EdNA Reference Committee (ERC). The ERC included members of both the schools and VET groups plus national officials and nominees from higher education as well as a member from Education.au (EdNA Reference Committee, 1997).

In addition, sectoral project officers met with Education.au and Commonwealth staff from time to time for the first two years (OLTC, 1997a, 1997b, 1997c) to ensure cross sectoral communication between the advisory committees and Education.au. The discussions at meetings of sectoral project officers informed the schools and training sectoral committees which were responsible for advising on the operational planning and implementation of EdNA. The sectoral project officers met frequently in a number of modes including face to face as well as meetings using group and individual emails, telephone, especially teleconferencing, and occasionally using commercial videoconferencing services. The use of diverse communications e.g. telephone, conferencing, and online services for collaborative planning and operational aspects of implementing EdNA became commonplace. In fact, one of the

earliest efforts using online collaboration was in 1998 when a web-based conferencing system was introduced to manage consultation about the progress of EdNA projects. The purpose of the system called *Caucus* was to 'streamline project management' and experience the 'software that was becoming widely adopted on the Web by both workgroups and dispersed communities'. (Education.au Limited, 1998b). *Caucus* enabled journal discussions and had the capacity to post meeting notes and documents as well as enable forum discussions and email alerts. The use of this system was mainly for information and services projects whereas overarching projects continued to use face to face meetings, teleconferences and email. *Caucus* was discontinued a year later possibly because the number of projects increased and a new and more detailed chart based project management method for scheduling and tracking projects was introduced (Education.au Limited, 1999a). There is no further mention of the Web-based conferencing system, *Caucus*, after March of 1999.

The need to communicate frequently on a national basis both by committees and those working to develop the EdNA service also led to the frequent use of email group distribution services as part of the EdNA Directory Service. Email distribution groups such as sectoral project officers, EdNA school's group, EdNA VET groups, ERC and other operational groups, were used prolifically to advance ideas, canvass opinions and notify decisions about developing and implementing EdNA. However, email services, although useful for distributing information were not seen to be ideal for decision making because of their asynchronous nature and non-uniform response periods. That is, a discussion could be well advanced among some members of a group when another member disrupted the discussion by responding to the initial email canvassing the issue. Emails also arrived out of order which caused some consternation at times for the sectoral project officers. However, the email distribution groups were the first of the interactive services widely available from the EdNA information directory service and were used prolifically. The email distribution groups were the beginnings of the online collaboration among EdNA participants.

EdNA launch and growth

As indicated earlier, the EdNA service was officially launched in November, 1997 by the then Minister for Education, Training and Youth Affairs, Senator Chris Ellison. When EdNA was launched it included agreed education categories, browsing and search functions, and a robust email group distribution service in place. The Australian gateway function or ‘one-stop-shop’ purpose of EdNA was a key concept emphasised at the launch (Ellison, 1997a). The Minister acknowledged the importance of collaboration in his EdNA launch press release which stated:

The launch of the EdNA Directory Service is the culmination of years of collaboration between the Commonwealth, State and Territory governments and non-government organisations, aimed at maximising the benefits of information technology in education and training (Ellison, 1997b, p. 1)

Then in July, 1998, the technical part of the EdNA service was physically moved from the Commonwealth Government's supervision to Education.au. Education.au's role was to coordinate the collaborative development and the management of the service. Education.au introduced a national education and training news service for each of the education sectors plus a noticeboard of national education events, conferences and celebrations. The transfer of the management of the EdNA service to the national agency, Education.au, strengthened the understanding of national and sectoral collaboration for the stakeholders involved (Education.au Limited, 1998c).

In this period of development, 1997 to 1998, collaboration of State and National government education and training officials with the agency about content and harvesting links was frequent and intense. Project officers for the Advisory Committees met physically and communicated regularly online with officers from the Commonwealth and Education.au to plan and advise on EdNA projects. As mentioned earlier, collaboration was undertaken by face to face meetings and through the use of the telephone and email services. Decisions arising from collaborative efforts were confirmed at meetings of the relevant Advisory Groups who reported to the ERC which determined the directions for EdNA. ERC also

undertook broad national consultations about the annual work program for EdNA that the States suggested needed to be completed for the coming year. Agreement by the ERC on the EdNA work program was a condition of funding from the Commonwealth to secure the annual funding for EdNA projects to be implemented by Education.au in the coming year. The use of email distribution groups during this extensive period of consultation was also an essential element in keeping members of the committees informed as well as enabling clarification of issues and the provision of advice to the States.

By 2002, EdNA had become a ‘meta-network’ of Australian educational practitioners (Lonsdale, 2002, p. 17). Lonsdale described EdNA as having ‘... access to thousands of resources but through its discussions, noticeboards and forums, it consciously fosters a sense of online educational communities’ (Lonsdale, 2002, p. 17).

Establishing online communities

The use of the group distribution of email led to the emergence of a number of online professional education communities outside of the operational and decision making groups responsible for the developmental plans for EdNA. For example, school librarians, mathematics teachers, language teachers, trainers and many more began to manage their professional association’s business and communication online. As can be seen from information on the number of email distribution lists by category in Figure 1, the school sector had the largest number of email distribution lists in 2008.

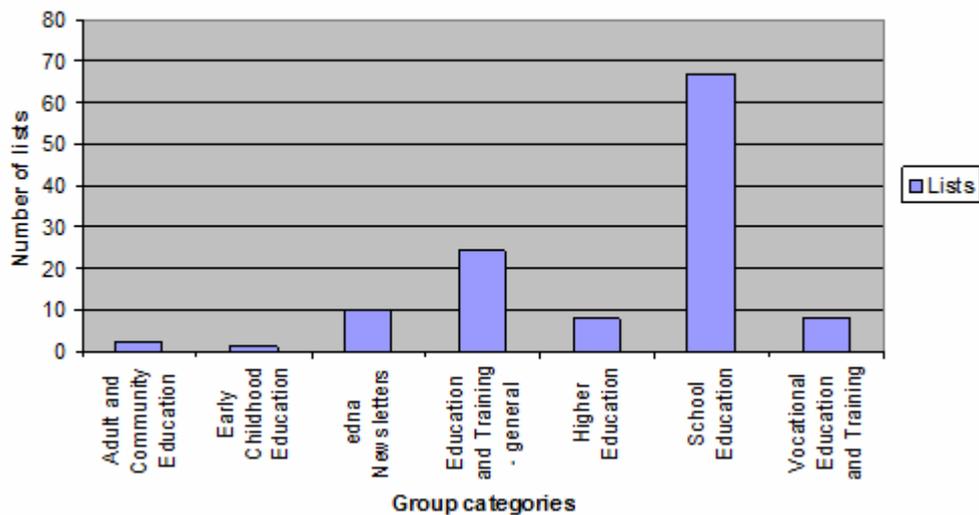


Figure 2.1: Email distribution lists by categories, 2008

However, by 2008, many distribution lists had moved to other and newer interactive community services available on EdNA, such as forums and groups although news syndication services continued to grow. For example, between 2004 and 2008 the number of EdNA Groups grew by 972% and the number of participants in Groups grew by 492% (Education.au Limited 2005a, 2008a) even though not all educational communities encouraged by the EdNA project used the EdNA online services. A notable example of a vibrant online community which utilised other online services and was encouraged by the EdNA project collaboration was the training sector's LearnScope project. This was a program agreed by the CEOs in the training sector which began in 1998 and then became a part of the *Flexible Learning for the Information Economy: A Framework for National Collaboration in Vocational Education and Training 2000 – 2004* (now referred to as the *Australian Flexible Learning [AFL] Framework 2000 – 2004*). In 2000, LearnScope was incorporated into the 2000-2004 Framework as a major online professional development initiative and adopted a culture of learning through work based learning teams which had the support of facilitators and mentors. Learnscope was supervised as a project by EVAG with funding distributed to the States to manage local projects for professional development although the activity was coordinated online nationally. EVAG was responsible for advising senior training officials about national issues

relating to the directions and priorities for flexible learning in VET, with particular reference to online technologies (Australian National Training Authority, 2001). LearnScope as a dynamic online community, at its peak in 2003, engaged nearly 15,000 trainers in over 300 projects and ‘at the practitioner level LearnScope has had the greatest impact’ (Australian National Training Authority, 2004, p. 6). In the AFL Framework 2005-2007, Learnscope’s funding was significantly reduced and its activities were moved to EdNA (Australian National Training Authority, 2005).

The accesses to EdNA increased steadily in the early years of the new century as can be seen in figures 2.2 and figure 2.3 below. In figure 2.2, the number of visits to EdNA between November, 2000, and February, 2003, increased from 75,000 visits to 200,000 visits. In figure 2.3 the number of page-views increased from about 600,000 in November, 2000, to 1.6 million page-views in February, 2003.

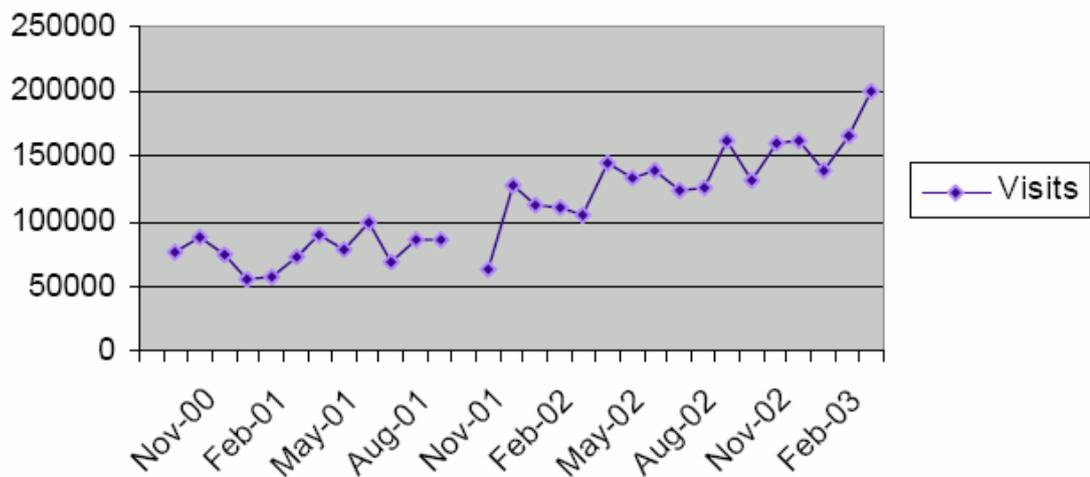


Figure 2.2.: EdNA Online visits (Putland, 2003, p. 3)

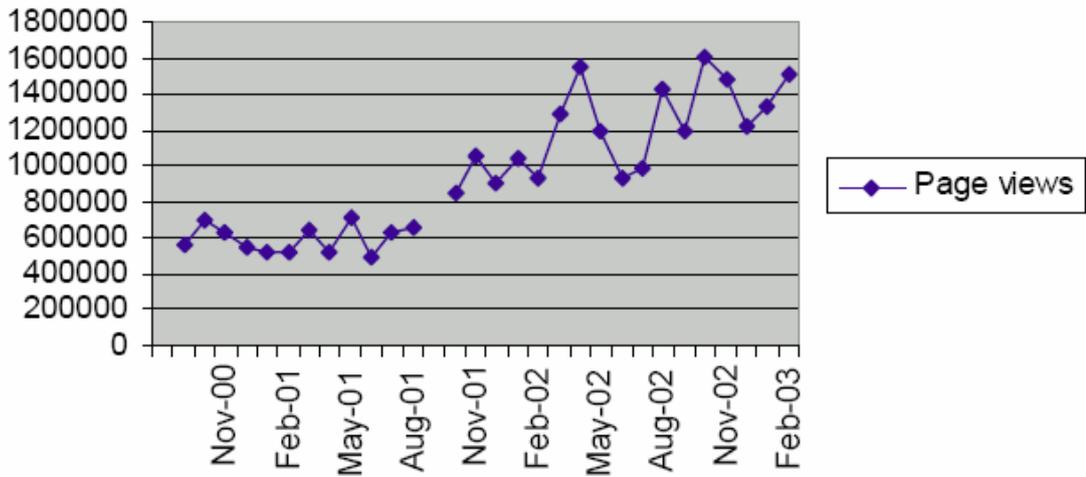


Figure 2.3: EdNA Online page-views (Putland, 2003, p. 4)

However, in the same period, the number of EdNA projects also increased as the States developed their own local services using EdNA applications. In addition, other national online services were being developed. One such notable national online service was the career information service called *MyFuture*. *MyFuture* was launched on 15 July, 2002 (Education.au, 2002a. p. 1) during a period of growth for EdNA. However, no evidence can be found in the documentation that indicates that *MyFuture* had an impact on the usage of EdNA. The use of EdNA did not appear to be related to the presence or usage of other separately developed and managed national online services unless they were directly related to EdNA applications.

Then in 2003, after a lengthy two-year national consultation period with States, EdNA was redesigned and relaunched as a global aggregator of quality educational resources with an integrated suite of collaborative web services. One of the main new features of the new EdNA suite of services was the innovative distributed search architecture which enabled EdNA to search multiple databases in real time. This meant that EdNA was able to search digital library collections, websites and repositories where reciprocal agreements for access to information and common metadata standards had been established. The effect of this was that EdNA users could search large databases of information through one EdNA entry point.

This new feature further increased usage of EdNA due to the wider access to quality educational resources from global databases. In addition, as the capacity for States to download and embed shared EdNA applications and services increased so did EdNA's usage increase. Shared EdNA applications embedded by the States in their own web based services included search and browse, forums, chat services, noticeboards and news feeds or content syndication. These shared information services were partly responsible for a rapid take up of the EdNA services between 2003 and 2004. As stated in the EdNA evaluation:

Usage of Shared Information Services in the final quarter of the evaluation increased by 342% in 12 months from an average 13,997 server requests (July-September 2003) to 61,834 requests for July-September 2004.

(Education.au, 2005a, p. 24)

The development of the new suite of EdNA services was very much a collaborative effort. As stated by Putland (2003, p. 18), collaboration was a fundamental aspect of the development methodology used in the transformation of the EdNA website to a suite of online services. This statement would appear to be an indication that collaboration was beneficial to EdNA's development through collaborative advisory groups and also in the formation of online education communities.

Interactive collaboration

In time, the sector Advisory Groups and the ERC developed briefs wider than EdNA, although EdNA remained an important part of their regular agendas. The ERC was renamed AICTEC in 2001 following its restructure (AICTEC, 2008; White, 2002) to engage with national ICT in education and training policy issues broader than EdNA across the three education sectors: schools, training and universities. Issues such as broadband, technical standards, copyright and infrastructure gained considerable national focus, and attention to EdNA became a monitoring role. The training sector's EVAG and school sector's SAG renamed their committees in 2001 removing EdNA from the names of their committees (Flexible Learning Advisory Group, 2008; EdNA Schools Advisory Group, 2001). EVAG became the Flexible learning

Advisory Group (FLAG) and SAG became the MCEETYA ICT in Schools Taskforce (ICT T/F). The intention of both committees was to focus more on ICT policies nationally and to act forums for new sectoral and common initiatives. For example, besides EdNA, the topics for the March 2002 ICT T/F agenda included Learning System Architecture, Online Content, Research, Regulation/Policy, Professional Learning and a section for State Reports. A report from Education.au Limited was tabled but not for discussion and EdNA was included in that report.

This series of changes had a two-fold effect. The first was the widening of interest in ICT issues in education and training, and the second a changed focus from singly focussed meetings and detailed accountability for the development of EdNA to a monitoring role by the sectors through the national AICTEC. As a consequence, Education.au, in 2001, established an EdNA Online Advisory Committee (EORC). The purpose of EORC was to ensure ongoing consultation about the direction and development of EdNA with the sectors and the States (MCEETYA ICT in Schools Taskforce, 2001). The change from three major committees engaged in the development of EdNA to a single body focussed on EdNA reduced the amount of time for the managers of EdNA to consult about the directions and management of the service. Consultations became more streamlined enabling speedier decisions about the future development plans for EdNA. In this new governance environment there emerged EdNA's first significant online web based collaborative service called EdNA Groups which was trialled in late 2004 and made publicly available in early 2005.

EdNA Groups was the beginning of a suite of collaborative web based online services enabling education participants to share and interact using text, audio, graphics, photographs, movies, links, and more recently online real-time discussions including online conferencing. The use of EdNA Groups enabled users to utilise the so-called Web 2.0 applications of the WWW. By December 2007, there were over 1300 groups with nearly 17,000 members who were logged as 117,568 unique visitors making 308,792 visits and viewing 7,529,886 pages (Education.au Limited, 2007a). The use of the interactive EdNA Groups service by education sectors was interesting because the training sector operated 420 groups whereas the schooling sector operated 351 groups, which was the opposite of the use of email distribution

lists where schools dominated usage (Education.au Limited, 2007a). The take-up of EdNA Groups can be seen to be quite rapid signalling that such a service was regarded as useful and valued by educators and trainers.

The growth of the EdNA services from a directory service to a collaborative and personalised interactive online service can be seen more clearly from the usage statistics. In Table 1.1 below, the number of visits to EdNA, as diversified search, collaborative and personalised services, between 2004 and 2008, can be seen to have increased, especially in the collaborative and personalised services.

	2004	2008	% Change
Search			
Monthly visits	168807	200000	26%
Listservs			
Members	42000	78400	87%
Forums/Groups			
Communities	146	1420	972%
Participants	4040	19900	492%
Personalised services			
Users/SSO	9014	30000	233%
Profiles	n/a	9000	

Table 2.1: EdNA usage: Comparison 2004 – 2008

Statistics taken from Education.au Limited, (2005a, p. 15), and Education.au Limited, (2008a, p. 5).

In Table 2.1 above, statistics taken from the *Demand and Value Assessment* of EdNA in 2004 and statistics prepared for 2008 and reported in the *National education.au consultations on Education Network Australia (edna)* (Education.au Limited, 2008a) about the use of EdNA, have been compared. The increases in usage of the Forums/Groups and the Personalised services which include the numbers for 'single sign-on' (SSO) users can be seen to have increased markedly.

Small increases in the use of the search and email list functions can be seen from the statistics, whereas the collaborative community and personalised services have experienced rapid take up and use by educators. The statistics for the distribution of the news services have not been included because the news services are included in the email lists, the groups and the personalised services as well as being distributed by RSS⁵ services.

Personalisation

The collaborative professional community in which educators were engaging can be more starkly demonstrated by viewing the steady take up of the personalised services. These services, although they first began in 2006, were launched in February 2008. They have enabled sharing of personal profiles and social networking.

In 2006, EdNA released a host of Web 2.0 interactive communication functions including blogs, audio feeds, wikis and personalised services such as personal searches, together with a rich base of easily accessible information resources. A new service, called MyEdna, enabled users to personalise their use of EdNA and to construct and save their own education profiles.

Then in January 2008, personalisation was taken a step further with the launch of '*me.edu.au*' personalised services. In announcing the forthcoming 'me' personalisation education service, the Commonwealth of Australia (2007) described it on EdNA's front page by stating:

The new system provides an online professional network where educators can identify their professional interests, join communities with similar interests, and view and respond to the activities of their online colleagues. It incorporates features of social networking sites to build professional communities. With further releases in the first half of 2008, *me.edu.au* will become a

⁵ RSS is a syndicated Web feed method for distributing news items and is an acronym for Really Simple Syndication.

comprehensive personal network and resource for Australian educators.
(Commonwealth of Australia. 2007, p. 1)

The national education and training online web service of EdNA had moved from being a single source comprehensive global resource based and collaboration online web service for education and training professionals, in the first instance, to become a personalised web service enabling the formation of communities of professionals with access to high quality educational resources and services. The growth of the EdNA personalised services can be seen from a comparison of statistics over the five month 2008 period, in Figure 2.4 below.

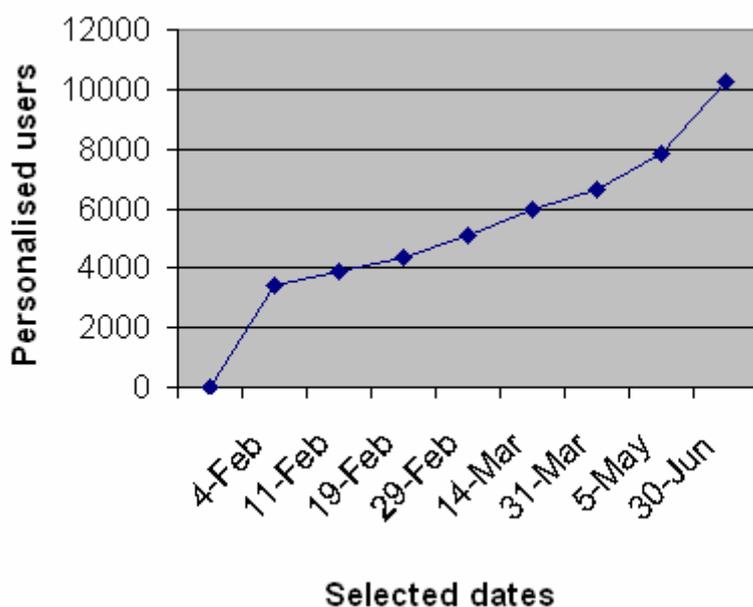


Figure 2.4: Personalised users by selected dates 2008 (EdNA server statistics)

The rapid growth of education communities with the EdNA Groups services and then the growth of the ‘*me.edu.au*’ personalisation services was an indication that teachers and education professionals appeared to value collaborative and personalised services. The EdNA server statistics reports have been compiled into a monthly record from the year 2000 until the end of 2009. From this compilation, graphs explaining the progress of EdNA have been composed.

EdNA's phases of development

The above chronological history of EdNA highlights five phases of its development covering the period from its initiation in 1995 to 2008. Those five phases were:

- The initiation phase 1995 to 1997
- A directory service of evaluated resources 1996 - 2009
- Shared Information Services 1996 - 2004, 2005 -2009
- Group collaborative services 2004 - 2009, and
- Personalised services 2006 – 2009.

These phases of EdNA's development, growth and management were used as a framework for the study as a whole, particularly the research reported in Chapters 5, 6 and 7.

Summary

This chapter has documented and unravelled the somewhat complex and convoluted history of the development and growth of EdNA which began in the early nineties, in a period of intense activity and concern about the use of information and communications technology in education. Computers as standalone devices had been used in education since the early eighties but were rarely networked using the Internet which was invented 1969 (Gillies and Cailliau, 2000). The AEC responded to the pressures of using computers in education and the availability of the Internet by forming the OLTC. The role of the OLTC, agreed in 1992 and formed in 1993, was to support the networking of technology in education by providing a brokerage for education and technology, and a clearinghouse for research and reports on the use of technology in education.

However, the invention of the WWW in 1989 and its rapid take up worldwide highlighted the potential for networking and was of interest to educational leaders. In the period 1991 to 1996 several national reports were commissioned by the

Commonwealth of Australia but none more important than the report of the Broadband Services Expert Group (BSEG), *Networking Australia's Future: Final Report* (Australian Government, 1994) in which it was recommended that networking in education to enable resource sharing and interactive communication was essential.

Based on the BSEG's recommendations the Commonwealth Minister for Education, Mr Simon Crean MP, announced in April, 1995, the formation of the AEN. This announcement was followed in May, 1995, by agreement of the States to be involved with the Commonwealth, to set up processes for determining the content needs, network services and reception infrastructure for EdNA. Almost immediately after the States had agreed to be involved, DEETYA established an internal departmental EdNA Networking Taskforce, purchased the equipment and software, and engaged a commercial software development company to configure the software and services.

In May, 1995, MCEETYA had expanded the role of OLTC to manage the governance of EdNA and the Board of OLTC was to be restructured by December of that year. At the same time a national consultative process for the purchase of reception infrastructure began and national consultations also began about the business requirements for the EdNA network. Then in 1996, the EdNA Reference Group was formed from the group that undertook the EdNA network business requirements national consultations and OLTC gained a new constitution to focus on EdNA commencing in 1997.

The constitution of the reformed national company, OLTC, specifically focussed on the governance of EdNA which was to be undertaken by collaboration and cooperation with the Commonwealth and States. EdNA was launched by the Commonwealth in late 1997, and the company was re-branded three months later in early 1998, as a national education technology agency, called Education.au Limited. Then in the latter half of 1998, the EdNA service hardware, software and services were transferred from the Commonwealth to Education.au and the Commonwealth reverted to a funding and supervisory role.

When EdNA was launched, it was a search and browse service of moderated and linked searchable items. There was an emphasis during the first years of EdNA to increase the content through contributions from the States in all three education sectors. However, the linked items, harvested by an EdNA robot, provided the bulk of the content that was discoverable. In 1998 the EdNA Metadata Standard 1.0 was approved by AICTEC and adopted as the metadata standard for education in Australia.

Online discussion and collaboration, to date, had occurred through emails and group distribution of emails or listservs. In 2000, EdNA introduced web based forums, which were the forerunner for Groups, as places for online discussion. Then in 2001, EdNA software applications were developed for the States to download and use in their own online services. Both online discussion services and improved search services increased the usage of EdNA although the number of accesses to EdNA through State services was unknown. EdNA Groups were trialled in 2003 and 2004, and finally launched in 2005. The take up of EdNA Groups by educators was rapid and increased the capacity of EdNA to enable online professional communities to form. Online communities were further enabled when MyEdNA was launched in 2006. MyEdNA enabled professional educators to connect and network by identifying common interests. MyEdNA was renamed as *me.edu.au* and enhanced with a wide range of so called Web 2.0 tools such as wikis, blogs, forums, tagging and then enabled podcasts and video-casts in 2008.

From its beginnings in 1995 and continued development to 2008, EdNA became an internationally recognised information and collaborative service for educators in Australia. Although the accesses to the information services of search and browse have steadily increased, the take up and use of collaborative services has been rapid.

An overview of the phases of EdNA's development can be listed as:

- The initiation phase 1995 to 1997
- A directory service of evaluated resources 1996 - 2009
- Shared Information Services 1996 - 2004, 2005 -2009
- Group collaborative services 2004 - 2009, and
- Personalised services 2006 – 2009.

For clarity and simplicity, the narrative has been summarised as *Summary of EdNA key events*, which can be located at Appendix 1. This historical account of the development of EdNA, while an important part of the study in its own right, also sets the scene for the remainder of the research undertaken. Subsequent chapters will return to this chronology many times, particularly in terms of its intersection with the theoretical framework for the study, developed from the literature review presented in the next chapter.

Chapter 3 Literature review and development of theoretical framework

Purpose and outline

The purpose of this chapter is to report on the building of a theoretical framework for this study. As indicated in Chapter 1, there is very little literature directly relevant to diffusion of innovations *in education*. Hence the position taken in this study was that a logical starting point for building a theory about the diffusion of innovations in education was the literature on diffusion of innovations more generally. The chapter begins with a review of the relevant literature, with particular emphasis on the seminal work of Everett Rogers spanning four decades from the early 1960s. Factors such as innovation, communication, time and rate of adoption, and social systems are discussed, in the context of a critique of the work of Rogers and others. The opening section concludes with a summary of the literature on diffusion of innovation.

Building on the previous discussion, especially of factors critical to education such as communication and social systems, the chapter then explores the concept of collaboration in the education context, leading to a discussion of distributed leadership. The literature on collaboration and communities of practice leading to virtual communities and online collaboration arising from social networking services is also reviewed. The section on collaboration then finishes with a summary of the literature and a new definition of collaboration in education.

The chapter next provides an overview of the literature search on diffusion of ICT and collaboration as they relate to ICT in education. The overview summarises the gaps in diffusion of innovation theory as applied to education and puts forward the view that these gaps in the theory could be overcome by including collaboration and leadership. It concludes with a statement of a new theory of the diffusion of ICT in education, proposing that:

the successful diffusion of an ICT innovation in education can be assessed by its antecedents, its rate of population take up and the strength of collaboration associated with its development and use.

Rogers' theory of diffusion of innovations

The diffusion of innovation (DoI) theory was first documented and published by Rogers as *Diffusion of Innovations* (Rogers, 1962) now in its Fifth Edition published in 2003. Rogers defines diffusion as:

A process in which innovation is communicated through certain channels over time among members of a social system. (Rogers, 2003, p.5)

Rogers' theory has dominated thinking about diffusion of innovations since 1962 and remains largely current and relevant today, especially in the context of this study of the diffusion of ICT in education, given as Rogers indicates (2003. p. 36) that 'most of the new ideas discussed ... are technological innovations'.

Diffusion and/or dissemination?

An important distinction between diffusion and dissemination is relevant here to clarify the language that is used throughout the discussion because these two words are often used interchangeably in the literature. Rogers (2003) suggested that the term diffusion was sometimes restricted 'to the spontaneous and unplanned spread of new ideas' (Rogers, 1995, p.6) as distinct from the term dissemination which related to the planned and directed spread of new ideas. In his theory of the diffusion of innovations Rogers used the term diffusion to mean both spontaneous and planned spread of new ideas.

More recent research in two reports to the Australian Learning and Teaching Council (ALTC-formerly the Carrick Institute) explored the meaning of the word dissemination in more depth, in comprehensive literature reviews of dissemination

and diffusion (Southwell, Gannaway, Orrell, Chalmers and Abraham, 2005; McKenzie, Alexander, Harper and Anderson, 2005). Southwell et al (2005) concluded that dissemination in relation to implementation in education:

is understood to be more than distribution of information or making it available in some way. While embracing this aspect, dissemination also implies that some action has been taken to embed and upscale the innovation within its own context (discipline or institution) and/or to replicate or transform an innovation in a new context and to embed the innovation in that new context.

(Southwell et al, 2005, p. 18)

This meaning of dissemination goes beyond the notion of ‘spreading ideas’ suggested by Rogers, strengthening the concept by including some deliberative action to adopt or embed an innovation, in a two-way process (not a top-down or bottom-up approach). Southwell et al (2005) argue that dissemination that uses one-way processes of information distribution is usually ineffective in the widespread adoption of an innovation. However, McKenzie et al (2005) go further and distinguish dissemination for awareness which is a one-way process, dissemination for understanding which includes interaction with adopters and dissemination for use which requires adaptation and implementation, resulting in a change in practice.

Drawing on the above analyses, this study, while recognising that the words dissemination and diffusion are often used interchangeably, defines dissemination as the spread of innovations or new ideas where a change of practice has resulted. Diffusion that results in the take up or adoption of an innovation and results in changed practices has been the focus in this study.

Dimensions of Diffusion

In his definition, Rogers puts forward four main elements of diffusion of innovation as processes, namely (i) innovation, (ii) communication channels, (iii) time and (iv) a social system. These four elements are discussed below in some detail.

(i) Innovation

Rogers conceptualises an innovation as an idea, practice or object that is perceived as new by an individual or other unit of adoption (Rogers, 2003, p. 12) where the newness may be expressed in terms of knowledge, persuasion or a decision to adopt. To a large extent, technology and innovation are integrally bound together in Rogers' (2003) theory of diffusion of innovation because it is technology that often is the cause of an innovation or disruption that becomes the object of study. He argued that there are usually some benefits for the adopters of an innovation although those benefits may not be clear in their minds at the beginning. He also argued that potential adopters only persist with an innovation after its benefits have become clear.

Rogers makes a further pertinent observation, about the adoption of technological innovation, especially innovation involving software. He argues that, with technology, a distinction is usually made between hardware and software even though technology is a mix of both. Where technology is almost entirely composed of information, that is software, there would appear to be methodological problems in tracing and observing adoption. He states:

Such idea-only innovations have a relatively low degree of observability and thus a slower rate of adoption. (Rogers, 2003, p. 13)

There is consistent agreement in the diffusion literature about Rogers' attributes of innovation (Bradford and Florin, 2003; Crum, Premkumar and Ramamurthy, 1996; Moore and Benbasat, 1991). In this research, the work of Rogers (2003) has been used because of its wide acceptability.

According to Rogers (2003), innovations have five major attributes:

- Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes.

- Compatibility is the degree to which an innovation is perceived as being consistent with existing values, past experiences, and needs of potential adopters.
- Complexity is the degree to which an innovation is perceived as difficult to understand and use.
- Trialability is the degree to which an innovation can be experimented with on a limited basis.
- Observability is the degree to which the results of an innovation are visible to others. (Rogers, 2003, p. 16)

Rogers proposes that:

innovations that are perceived as having greater relative advantage, compatibility, trialability and observability and less complexity will be adopted more rapidly than other innovations. (Rogers, 2003, p. 16)

However, in explaining the sustainability of an innovation Rogers introduces also the concept of re-invention which he defines as:

the degree to which an innovation is changed or modified by a user in the process of adoption and implementation. (Rogers, 2003, p. 17)

Rogers goes on to advance the view that diffusion can be more rapid and its adoption more likely to be sustained when it can be re-invented or modified. The attributes of an innovation and the capacity for modification or re-invention are an indication of the likelihood of the success of an innovation in Rogers' (2003) view.

Others have expanded Rogers' key attributes in ways pertinent to this research. Wilson et al (2000), for example, included *support* as a key attribute of innovation when researching adoption of learning technologies in schools and universities. Support in the context of innovation in education includes encouragement by leadership and authority, valuing of the efforts of innovators, sharing successes and challenges with a view to seeking best practice, and timely technical support when needed (Wilson and Bray, 2000). There is also one attribute of innovation, 'complexity', that indicates a barrier to the successful adoption of an innovation. In

the diffusion of ICT, seven attributes – also known as antecedents – are therefore pertinent:

- relative advantage
- compatibility
- trialability
- observability
- complexity
- support and
- modification or reinvention.

(ii) Communication

Rogers (2003) argues that diffusion is a special kind of communication where content messages are exchanged about new ideas and where there are adopters and non-adopters, as well as communication channels to link the two persons or groups to consider the new idea. That is, the non-adopter, through a communication channel, discusses the new idea with an adopter. Adoption usually comes from interactions between individuals or groups, and imitation and modelling of the new practices by those who have adopted the innovation. He notes the prevalence, in more recent times, of interactive communication using the Internet to form networks.

Rogers indicates five innovation-decision stages, which vary from one context to another, through which an individual or group proceeds in adopting an innovation, with communication critical to each stage. The stages are:

- knowledge, i.e. where the innovation becomes known, and when communication through mass is likely to be important
- persuasion, i.e. where an attitude towards the innovation is formed and where interpersonal communication is critical
- decision-making, i.e. where the decision is made whether or not to engage
- implementation, i.e. where the innovation is used and often re-invented or customised, and

- confirmation, i.e. where reinforcement of a decision is made.

(Rogers, 2003, p. 20)

Rogers argues that the effectiveness of interpersonal communication is enhanced by commonalities such as socio-economic status and education between the communicators. Indeed, he sees diffusion as a social process where potential adopters engage with network partners to decide subjectively whether to adopt an innovation. He points out that adoption is based on the modelling and imitation of those who have already adopted an innovation and that adoption is more likely for like minded groups which he calls 'homophilous' groups. Homophilous individuals or groups share the same values and meanings, and are often from the same social groups as well. Rogers states:

More effective communication occurs when two or more individuals are homophilous.

(Rogers, 2003, p.19)

Homophilous individuals use the same language and concepts when communicating, and can be considered as part of the same group. However, acceptance of new ideas is rarely introduced by homophilous individuals because of a shared environment, values and meanings. Although homophilous communication appears to be useful in adopting an innovation, Rogers argues that like minded individuals are less likely to have new information to communicate and so change is unlikely.

On the other hand, change does occur between individuals when communication of an innovation is 'heterophilous' Rogers (2003, p. 21), that is, the individuals are not like minded. Heterophilous communication is when individuals do not share the same meanings, values and interests and so they have different interpretations of new ideas especially technical ideas.

Rogers (2003) asserts that communication of an innovation by experts or change agents, occurs between heterophilous individuals. The change agent, who is usually external to the organisation or group, is more technically competent than the members of the social system, although this situation, if not carefully planned, can often lead to ineffective communication because of issues arising from non shared

language and meanings. However, in Rogers' (2003) view, the differences in meaning that occur during heterophilous communication can be narrowed through planning agreed processes and engaging influential members of the social systems.

In education, teachers as professionals continue their learning through interactions with colleagues as homophilous interactions. That is, teachers engaging in professional development are more likely to be like minded and engage in homophilous communication leading to confirmation of existing practice but ineffective diffusion of innovation. In discussing models for teacher professional development DEST (2001) reviewed the literature and concluded that effective professional development is:

collaborative and interactional, involving a sharing of knowledge among educators and a focus on teachers' communities of practice rather than individual teachers. (DEST, 2001, p. 19)

This gives an indication of the support that teachers gain from one another as homophilous communication occurs. It also highlights the nature of heterophilous interactions with change agents, external to the organisation, to potentially cause some communication difficulties through a lack of sharing common knowledge and understandings as well as not being a part of the teachers' community of practice.

As indicated above, heterophilous communication can be seen as a barrier to effective communication, in diffusion of innovation in education, unless agreed processes are planned and that does require leadership within the social system and agreement by the individuals to participate. Agreed processes that maximise homophilous communications and reduce the uncertainties of heterophilous communications would appear to optimise the adoption of an innovation. The type of leadership within the social system needed to clarify the ambiguities and confusion of a change agent's heterophilous communication to a group of homophilous professional teachers will be discussed later in this chapter. However, where differences in meaning occur between change agents and professional teaching homophilous communities, the issue of time becomes a major factor affecting

successful diffusion – time to be aware of, to understand and to adapt or adopt an innovation.

Rogers' (2003) five innovation-decision stages - knowledge, persuasion, decision-making, implementation and confirmation - usually taken in order, are highly relevant to the adoption of an innovation, including technology, in education. The exception is when an innovation is required by an authority to be adopted in which case the decision stage precedes the persuasion stage. Rogers (2003) points out that it is the interpersonal networks within the social system that are likely to support the decision to adopt an innovation. That is, the interaction between peers and the influence of champions within the social network is crucial to adoption or otherwise of an innovation.

(iii) Time

The origins of diffusion research began around 1900 with Gabriel Tarde, a French lawyer and judge, who noted that the rate of adoption of an innovation usually followed an S-shaped curve. Then in 1948, in a study of the adoption of hybrid corn among farmers, Ryan and Gross (Rogers, 2003) noted the same pattern of adoption occurred among the farming community. Rogers went further, based on a number of studies, and proposed innovator categories based on the time taken for innovators to adopt an innovation. Trinidad et al (2005) refers to this type of adoption model of diffusion of innovation as a population model because both the rate of adoption and adopter categories are demonstrated by population measures.

The take up of an innovation depends on the innovativeness and adopter categories of the potential adopters both of which can be measured by the relative time to take up a new idea. The rate of adoption is the relative speed of members of a social system to take up an innovation that can be observed as the gradient of an adoption curve. The rate of adoption is a critical concept in diffusion theory which Rogers describes as the time taken for the members of a social system, measured in percentages, to adopt an innovation. Rogers (2003) depicts the adopters and time taken for them to adopt an innovation as an S-shaped curve as seen in Figure 5.

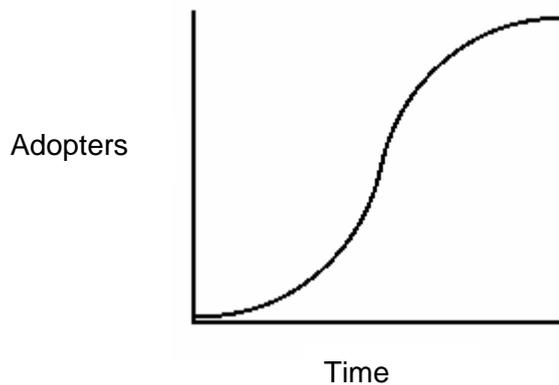


Figure 3.1: Rate of adoption (Rogers, 2003)

In this way slow take up initially is depicted as giving way to increased adoption and then finally, as the change trails off when almost complete the graph reaches its asymptote. The ‘S-shaped adopter distributions closely approach normality,’ states Rogers (2003, p. 280) who suggests that diffusion of innovations goes through these stages as a normal occurrence with the time to adoption as a variable factor.

Rogers details five categories of adopters: innovators, early adopters, early majority, late majority and laggards. Innovators adopt an innovation as part of the first 2.5% of a social system and are known for their technical competence. They are often change agents external to the social system and therefore do not have the credibility of opinion leaders within the social system. Change agents usually engage in heterophilous communication which can cause confusion because of the differing value sets and technical understandings of the change agents and social system members. As mentioned previously, change agents are known to enlist the support of influential members of the social system in order to maximise the benefits of homophilous communications and minimise confusing language. This confusion can be further minimised where agreed communication processes are planned by the leaders.

Early adopters by comparison are usually the individuals within the social system or community chosen because of their influence and are part of the next 13.5% of adopters. They are influential role models respected by their peers and are often

considered champions but not necessarily leaders. Early adopters are important in stimulating the take up of an innovation by the next group called the early majority which make up the next 34% of adopters. The early majority make up a third of the adopters and are very active in communicating through their interpersonal networks. The decision by early adopters to adopt an innovation is quite deliberate but early adopters rarely lead an innovation. The late majority which make up another 34% of adopters are usually sceptical about the changes, possibly due to scarcity of resources and changed practices. They need to be convinced that the innovation is an improvement and often only adopt an innovation due to peer pressure or economic necessity largely brought about by the take up of an innovation by the early adopters and the early majority.

Finally, the so called laggards are extremely cautious in adopting an innovation and only do so because of economic pressure. They must be certain that the innovation will succeed before they adopt and they tend to focus on the past. Laggards make up 16% of the social system and can become social isolates. The adopter categories based on their innovativeness are shown in Figure 3.2 below.

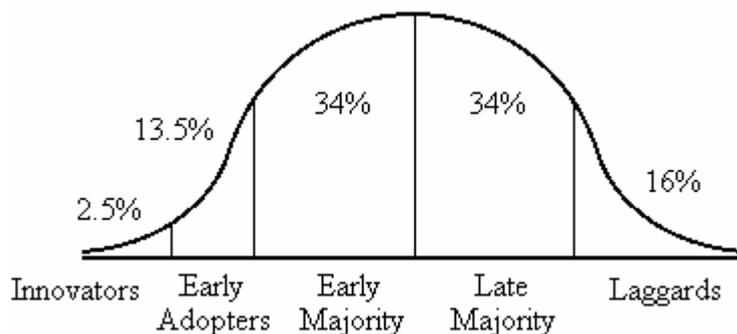


Figure 3.2: Adopter Categories on the Basis of Innovativeness (Rogers, 2003, p. 281)

In figure 3.2 above, the critical mass of adopters can be seen to occur during the early adopter stage, commencing at 15% of the bell curve and the bulk of 68% as early and late majority adopters. The time taken to adoption will be affected by the social system and its structures, and the opinion leaders. That is, there is a common pattern of adoption of innovations although the time taken varies which alters the gradient of

the S-shaped curve. Rogers posits that the major factors affecting the time taken to adopt an innovation are the communication channels and the social system.

(iv) Social system

Rogers describes a social system as ‘... as set of interrelated units that are engaged in joint problem solving to accomplish a common goal (Rogers, 2003, p. 23). Social systems have structures in which individuals behave through an understanding of the norms and also a communication structure. Both the social and communication structures of a social system can facilitate or impede diffusion of an innovation.

Within social systems, opinion leaders or champions have a major influence on the attitudes and behaviours of other members. Opinion leaders within the social system are often sought by others for informal guidance and discussion of an innovation. However, change agents who are professional people with technical expertise, are usually outsiders to the social system. Change agents often work through opinion leaders provided that the gap between the innovation and current practice does not deviate too far from the norm. Opinion leaders operate through a communication network and act as social models to be imitated by other members of the social system. Opinion leaders within the social system are very important to the change agents because opinion leaders are influential through the effectiveness of their homophilous communication. That is, opinion leaders understand the shared values and meanings of the social system and its context, and can effectively communicate the new ideas and benefits of an innovation introduced by the change agent through their social channels.

Rogers argues that social systems have an important effect on diffusion of innovations and the types of innovative decisions because of the supportive structures that they provide or the barriers that affect diffusion. For example, he states that:

Collective and authority decisions are more common than optional decisions in most organizations, such as ... schools, or government organizations, in

comparison with other fields... [and] generally, the fastest rate of adoption of innovations stems from authority decisions although authority decisions may be circumvented by members of a system during their implementation.

(Rogers, 2003, p. 29)

Change agents bring with them a language that is usually considered technical and expert. Rogers (2003) suggests that this can lead to confusion and ambiguity, thus acting as a barrier to adoption among the target audience for adoption. However, where change agents engage the support and influence of the leaders and opinion makers within the social system then these barriers can be minimised. Rogers (2003) argues that there usually exist shared values and agreed meanings about the proposed changes among the potential adopters who look to the opinion makers for information and guidance. The opinion makers within the social system understand those shared values and agreed meanings as well as being accepted by the group. Effective or homophilous communication between individuals within a social system can be a sign of a successful diffusion of an innovation especially where 'outside' ideas are introduced and are then supported by the opinion makers within the social system. A value chain of communication would appear to emerge during the take up of an innovation, progressing from change agents as innovators, to early adopters (who include opinion makers and influential social system leaders), to the early majority and then, finally the late majority and laggards.

Applying and building on Rogers' theory in the context of education

Rogers argues that 'most teachers and school administrators are involved in collective and/or authority innovation decisions' (Rogers, 2003, p. 60). As noted above, teachers usually engage with innovation based on decisions by authority and with accepted local leadership, teachers adopt innovations through collective action which is consistent with professional teachers' culture. Rogers (2003) argues that, generally, the fastest rate of adoption of innovation stems from authority decisions depending on the innovativeness of the authorities. Although authority decisions and leadership are not the same, leaders in education do require authority to initiate and sustain large scale innovations. The context of education for successful innovation

includes both leadership and collaboration. The collaborative culture of education and teacher professional development is not part of Rogers' (2003) theory but needs to be taken into account. Collaboration is therefore discussed below and a discussion of leadership in a distributed environment is also included because of its importance in collaboration.

The literature on the professional development of teachers (Hawley & Valli, 1999; Brand, 1997; Brown & Ritchie, 1991; Kinnaman, 1990) is quite clear in that the social system of teachers is a collaborative and sharing environment when new ideas are being considered. In a review of the literature for models of ICT specific professional development DEST (2001) discussed the principles for effective professional development of teachers. A set of principles listed by Brand (1997) and quoted by DEST stated that, 'effective technological development of teachers takes place in a collaborative learning environment' (DEST. 2001, p. 21). The social system of teachers is collaborative and so a discussion of the diffusion of new ideas such as ICT needs to include a discussion about collaboration. A discussion about collaboration has been included below to build on the work of Rogers (2003) who has provided important aspects of diffusion such as the attributes of an innovation and the rate and stages of adoption, the categories of adopters and factors that affect communication within the social system.

Summary of literature on diffusion of innovation

In summarising diffusion of innovation, this study has focussed on Rogers' theory because it has been developed over a long period, 1962 to 2003, it is robust and has strength in description enabling reflection and analysis. As argued here, it is also applied readily to education.

There are four main elements in Rogers'(2003) definition of diffusion: innovation, communication, time and the social system. These four elements are present in the take up of ICT in the collaborative culture of educators and are important in understanding the success indicators and barriers to that take up. As noted above, however, the collaborative culture of education and teacher professional

development is not part of Rogers' (2003) theory but the addition of this element to his theory enhances its application to education.

Rogers argues that take up of an innovation can be graphed as an S-shaped curve to show the start of an innovation through change agents or innovators to champions then the early majority followed by the late majority. Finally, the laggards who change because they are forced by the social system or employment and economic conditions, are the last to adopt an innovation. The diffusion of ICT in education can be mapped against the stages of adoption and the time taken for each category to adopt ICT in education.

Rogers (2003) argues that an innovation will be more rapidly adopted if the attributes of relative advantage, compatibility, trialability and observability are seen by individuals to be greater than other innovations but with less complexity. In addition, re-invention and modification support an innovation to diffuse rapidly and have a positive effect on the sustainability of an innovation. Rogers (2003) also argues that generally, authority decisions by innovative leaders do lead to faster rates of adoption and in education this is often a necessary condition for communication about an innovation to occur. Rogers' discussion of communication and social systems highlights the need to explore the collaborative nature of education in which innovation takes place.

Rogers goes further by adding that the take up of an innovation by an individual goes through a series of innovation-decision stages which include knowledge about the innovation, persuasion, a decision to adopt, implementation and confirmation. Again, the communication channels within the social system of teachers are critical to the time taken to go through the stages of adoption of an innovation. In the culture in which educators work and professionally develop, these stages need to be seen as occurring in a collaborative educational context. Therefore to gain a fuller picture of diffusion of ICT in education a discussion on collaboration has been included below.

Collaboration in the education context

As emphasised above, communication and the social system in which communication takes place are critical elements of Rogers' (2003) theory of diffusion of innovation. In the social system of education, communication takes place through collaboration among colleagues when an innovation is being adopted or considered for adoption. The discussion below builds on Rogers' work on communication within the educational context and explores collaboration as it has grown with ICT and then positions that discussion within education to help to understand diffusion further.

Several commentators and researchers have focused on collaboration in professional learning among educators. Dede (2000), for example, argues that ICT can enable active collaboration for professional development of educators:

Emerging technologies enable a shift from the transfer and assimilation of information to the creation, sharing and mastery of knowledge. Active collaboration among educators in developing insights about innovation is more powerful in fostering effective implementation than simply receiving data about what someone else has done. This shift from assimilation to sharing about best practices potentially increases both the speed and the effectiveness of generalizing and applying educational innovations. (Dede, 2000, p. 1)

Candy (2004) also acknowledges that by using technology collaboration provides a new potential for lifelong learners in education. Candy stated:

As proponents of lifelong learning have advocated opportunities for people to learn from one another, and indeed to create new knowledge through interactions, digital technologies may offer new potentials for collaboration.

(Candy, 2004, p.311)

The term collaboration has been widely popularised by writers focussed on the applications of the Internet in recent years, although collaboration was a word used infrequently to refer to organisations working together prior to the Internet

(Himmelmann, 1993). Mass collaboration has been debated and discussed by Rheingold (2002), Tapscott (2006) and Elliott (2007). Frameworks for collaborative learning have also been developed by educators (Gifford, 1999; Curtis, 2001; Lehtinen, Hakkarainen, Lipponen, Rahikainen, and Muukkonen, 2003) and teacher-librarians (Monteil-Overall, 2005). However, this research is concerned with diffusion of ICT in education and the collaborative context in which teachers work together. That is, collaboration is the culture in which education professionals learn especially in learning about the use of ICT in education. This is not to deny the pivotal role of governments as the authorities in stimulating the take up of ICT in education.

The use of the term ‘collaboration’ in Australian Government programs is consistent with the federated nature of Australian Governments. Indeed the Australian Government Minister for Education, Julia Gillard (2007), in talking about initiatives in higher education, used the term ‘collaborate’ when describing the way that a number of national bodies would work together to bring about change and innovation.

Federal collaboration can refer to endeavours where the national Australian Government works on a project or projects with the Australian State Governments. State Governments are constitutionally charged with the provision of education in schools, programs in vocational education and training, and oversight of higher education. For example, in the *Adelaide Declaration on National Goals for Schooling in the Twenty-First Century*, it is stated:

The achievement of these common and agreed national goals entails a commitment to collaboration. (MCEETYA, 1999)

This was extended nine years later by the *Melbourne Declaration on Educational Goals for Young Australians* (2008) which stated that:

Australian Education Ministers seek to achieve the highest level of collaboration with the government, Catholic and independent school sectors and across and between all levels of government. (MCEETYA, 2008, p. 5)

Collaboration is a word often used in the national context when the Commonwealth and States seek to work together on a new issue.

Defining Collaboration

The term collaboration has different meanings in different contexts. The section below discusses some other uses of the term collaboration and then defines collaboration as used in this study.

(i) Uses of the term collaboration

Collaboration in education would appear to have become a well used term over the last few years, in a number of contexts. Three contexts relevant to this research are:

- at a government systems level for federal agreements, as discussed above
- at learning and professional levels for teachers and educators, and
- online through social networking technologies which have come to the fore strongly since 2001.

The literature search reveals no agreed meaning or theory of collaboration although Wood and Bray (1991) called for a general theory of collaboration, Gray (1989) argued that collaboration was about problem solving, Nelson et al (2008) discussed collaborative inquiry as an effective process for professional development, Elliott (2007) proposed a theoretical framework for mass collaboration, Cavanagh (2008) defined collaboration as a process where different issues were explored in a search for solutions that went beyond the members' limited vision and Lomas (2008) defined collaboration as working together to 'produce or create something' (Lomas, 2008, p. 2).

In order to define the meaning of collaboration, a good starting point is to distinguish it from other commonly used words such as networking, coordination and

cooperation which are often used almost interchangeably. In the work by Himmelmann (1993) a beginning is made on a definition of collaboration by distinguishing it from these other similar words. In his words:

Collaboration is exchanging information, altering activities, sharing resources and enhancing the capacity of another organization, for mutual benefit, and to achieve a common purpose. (Himmelmann, 1993, p. 1)

In Himmelmann's (1993) definition above there are three levels of working together. Collaboration goes a step further than cooperation by enhancing the capacity of another organisation and two steps further than coordination whereas networking is simply exchanging information. Collaboration is described as a more engaged level of working together than networking, coordination and cooperation in Himmelmann's (1993) useful summary of the differences. However, this is a static rather than a dynamic definition in that collaboration is seen as a mechanism to achieve a common goal for mutual benefit and capacity enhancing without further knowledge creation.

Education.au (2004a) described collaboration as involving the exchange of information, the sharing of resources and the enhancement of the capacity of an individual, team or organisation for mutual benefit, and to achieve a common purpose. This view of collaboration is closer to cooperation and describes a process for solving problems and achieving commonly agreed goals.

Collaboration however is more than a mechanism for cooperation. As conceptualised by Monteil-Overall (2005) it is both dynamic and creative with an 'underlying assumption... that meaning and knowledge are co-constructed' (Monteil-Overall, 2005, p. 3).

Monteil-Overall's views are close to those proposed by Schrage (1990) who sees 'Collaboration [as] the process of shared creation' (Schrage, 1990, p.40-41). The two definitions of Montiel-Overall (2005) and Schrage (1990) explore the co-creation of knowledge through interactions between individuals or groups to arrive at shared processes, understandings, products or events that they could not have done alone.

Collaboration as co-creation is a process for adding value and in that sense is more than routine cooperation but creative and somewhat unpredictable.

The notion of collaboration involving co-construction or co-creation will be revisited later and is a recurring theme in the literature. Rosen (2007), for example, provided useful insights into the ideas of collaborative culture and a collaborative environment, describing how he envisions collaboration unfolding in an enterprise environment and where value is created. Rosen viewed collaboration as including a dynamic process which creates value and is more than a mechanism for achieving an agreed goal. Rosen (2007) defined collaboration as 'Working together to create value while sharing virtual and physical space' (Rosen, 2007, p. 6).

Rosen's (2007) concept of 'sharing virtual and physical space' is pertinent to this study, because of the implication that technology may have an important role to play in collaboration which goes beyond traditional structures. In fact, Rosen (2007) cites Schrage (1995) who suggests that traditional community structures cannot achieve value creation to the same extent as collaboration. Rosen states:

Of some interest here is the work of Schrage (1995) who writes that collaboration describes a process of value creation that our traditional structures of community and teamwork can't achieve. (Rosen, 2007, p. 8-9)

Sharing physical and virtual space takes into account the synchronous and asynchronous nature of a number of electronic processes such as email, journals, messaging, video casting, blogs, wikis, online collaboration, online conferencing, document sharing, webinars and similar online applications.

There is an implication here that a new capacity associated with the Internet has enabled collaboration which is a more powerful process for value creation than teamwork and community. This is the position put forward by Rosen (2007) in his definition stated above. Rosen's idea of the creation of value takes up the co-creation of knowledge idea proposed by Schrage (1990) and Montiel-Overall (2005) and his definition proposes a more dynamic and robust understanding of collaboration than one which reflects the achievement of goals.

Rosen (2007) puts forward ten cultural elements that are typically present when collaboration works:

trust, sharing, goals, innovation, environment, collaborative chaos, constructive confrontation, communication, community and value. (Rosen, 2007, p.9)

Rosen's list of ten elements which operate at business and professional learning levels would appear to include discrete elements where effectiveness may be judged by the level of activity for each element. For example, the level of sharing could be judged as either mild, medium or strong as evidenced by the amount of material and information that was shared. Rosen's list is useful in consideration of large scale business-wide collaborative implementations by education systems; such as a combination of education departments working together at a national or state level. Rosen's ten elements could be useful for describing system level collaboration because it can be applied to large scale processes although there is not a clear distinction between collaborating in virtual and physical space. In addition, several of the elements lack precision, such as collaborative chaos, communication, and constructive confrontation, and seem to be more useful on a comparative basis than being subject to item measurement. In addition, there is no mention of leadership which educators and teachers exercise on a daily basis in their learning environments.

(ii) The term “collaboration” as defined and used in this study

Taking the above discussion into account, the issues that emerge in relation to collaboration include:

- collaboration as a process involving co-creation and co-construction
- collaboration as involving technology in some way
- collaboration as involving sharing physical and virtual spaces.

The definition of collaboration in education developed and used in this research is therefore as follows:

Collaboration is the process of co-creating knowledge while sharing physical or virtual space.

This definition takes into account the dynamic process of creating knowledge consistent with the purpose and culture of education as well as the process of sharing and working together online and offline. This definition provides a useful guide to tracking how collaboration occurs in education because by using Rosens' 10 elements as a starting point, the processes can be described and the success indicators rated.

Other writers such as Himmelman (1993), and Lendrum (2000) have put forward lists of characteristics and conditions for collaboration and alliances to be effective. However, the lists of requirements from these writers would appear to be similar but less comprehensive than Rosen's work.

Collaboration and leadership

The literature on leadership in education touches on the concept of distributed leadership as occurring in a collaborative environment. Although distributed leadership has also been written as collaborative leadership and shared leadership, the research in the effectiveness of this type of leadership seems to be scant. Several writers (Anderson & Cawsey, 2008; Dinham, 2008; Spillane, 2007; Harris, 2004; Gronn, 2002) highlight the emergence of distributed leadership in education arguing that it is a social practice among teachers and includes the leadership activity that occurs. Gronn (2002) describes distributed leadership as additive with more leaders and spread leadership, and secondly, takes into account all forms of collaboration and participation. Leadership is an important part of collaboration because as Wenger (1998) suggested, teachers operate within communities of practice which provide opportunities to lead. This type of leadership has been described as distributed leadership (Gronn, 2002). Rosen's ten elements of collaboration also fall

short when addressing collaboration at the group or individual level, that is, where teachers collaborate and groups of teachers collaborate, because leadership has not been included.

Education.au Limited has produced a list of ten characteristics of collaboration that appear to address more effectively the concept of collaboration in an educational environment. They are applicable to both virtual and physical space and take into account collaboration between teachers, groups of teachers and individuals as well as include leadership. The characteristics are:

shared leadership, common goals, shared process and framework, shared decision making, mutual responsibility, change resilience, network intelligence, flexibility and responsiveness, open communication and diversity in thinking.

(Education.au Limited, 2004a, p. 1)

This list of characteristics could apply to a school or group of educational institutions as well as a national or system level in education or individuals working collaboratively face to face or online. These characteristics of collaboration are robust and a discrete set of items that can be assessed. However, the real strength of Education.au's list of characteristics of collaboration is that it complements and expands the new definition of collaboration seen above and it is educationally based.

The difference between the two lists by Rosen (2007) and Education.au (2004a) relates to the purpose for which each is described. Rosen (2007) developed his list of elements for use by businesses and Education.au (2004a) developed their characteristics to describe collaboration in education. Although Rosen's (2007) definition of collaboration is applicable in several contexts, it is apparent that the characteristics that indicate collaboration are contextually bound. That is, the characteristics for collaboration in business are different to those applicable to collaboration in education. There is a greater expectation for teachers as leaders in the educational process than for those engaged in business to be leaders. This is not surprising because the characteristics of collaboration reflect the organisational patterns of each enterprise and the culture in which collaboration takes place.

These characteristics of collaboration advanced by Education.au are affirmed by the more recent work of Clark (2008). Clark (2008) also arrives at a list of ten characteristics of collaboration which were:

- (1) ongoing learning and continuous development
- (2) flexibility
- (3) trust
- (4) respect/esteem/ positive/regard
- (5) willingness/commitment
- (6) facilitative process and inclusivity (process capability/ tacit knowledge of functional group process establishment of norms, ground rules/agreements)
- (7) realistic optimism/resiliency/positive personality/solution/strength/future focus
- (8) communication skills
- (9) social intelligence (transcending the ego, ability to self-organize and motivate)
and
- (10) an appropriate level of technical competence (Clark, 2008, p. 131).

Clark's list is similar to that of Education.au and adds further explanation for each. However, there is one additional characteristic in Clark's (2008) list stated as an 'appropriate level of technical competence' (Clark, 2008, p. 131) which has been included in this study. Clark (2008) argues that this is a standalone characteristic and relates to a 'contribution of expertise' or 'familiarity' with the hard or technical skills to successfully achieve the group's functions and purpose (Clark, 2008, p. 131).

The discussion above has put forward a definition of collaboration in education and drawn on the characteristics of collaboration proposed by Education.au (2004a) and Clark (2008). The characteristics of collaboration used in this study were:

- *shared leadership*
- *common goals*
- *shared process and framework*
- *shared decision making*
- *mutual responsibility*
- *change resilience*

- *network intelligence*
- *flexibility and responsiveness*
- *open communication*
- *diversity in thinking, and*
- *appropriate level of technical competence.*

However, education operates within a professional community at various levels. Such communities may include a school community, a professional teacher community for professional development, a community of educational administrators and decision makers, and the like. A discussion on collaboration would not be complete without a review of communities as suggested by the definition which states that collaboration is a process that operates in physical or virtual place. In fact, Tapscott (2006) argues that without community there can be no collaboration.

Communities

Collaboration reflects a coming together of parties for a common purpose which, according to Lave and Wenger (1991), can also describe a community of practice. Lave and Wenger (1991) coined the term *communities of practice* in their work on the relationship between apprentices and their more experienced colleagues. They then applied the concept more broadly noticing that it was an appropriate way to describe many groups working together. Wenger (2004) defines communities of practice as:

groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. (Wenger, 2004, p. 1)

Communities of practice or groups working together are essential for collaboration to take place and as Rheingold (2000) suggested the advent of new communication technologies has given rise to virtual communities. Virtual communities can be thought of as communities of practice using technology to work online. Rheingold (2000) defines virtual communities as:

social aggregations that emerge from the Net when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace. (Rheingold, 1993, p. 3)

Virtual communities have become prolific on the Internet using web based collaborative communication technologies, especially since 2001, when social networking technologies became popular. Collaborative technologies have enabled virtual communities to share documents, text, audio, graphics, animations and video as well as a combination of several capabilities in a web based environment. That is, collaborative technologies have enabled collaboration to take place in virtual as well as physical space which has been acknowledged by a number of writers (Rheingold, 2003; Tapscott, 2006; Elliott, 2007; Rosen, 2007).

Communities are important in education as well, especially for teacher professional development and to build effectiveness. Research into the performance of individual teachers has revealed the importance of learning communities in influencing individual teacher effectiveness (Dinham, 2008). Building collaboration and community amongst teachers has been found to be effective in both promoting teacher professional development and enhancing educational outcomes for students (Watson and Steele, 2006). The literature search indicates that collaboration by education systems, and collaboration among professionals and learners has not been a focus for research (Monteil-Overall, 2005). However, the increase in the use of the Internet and web based communications technologies have given rise to a surge in virtual online communities and networks of collaborators in education (Schrum and Levin, 2009). A brief review of the history of online collaboration is timely here.

Online collaboration

Online collaboration is dependent on the Internet. The development of the Internet in 1969 was based on a standard known as the Transport Control Protocol/Internet Protocol version 4 (TCP/IP v4). The World Wide Web (WWW) was launched by Robert Cailliau and Tim Berners-Lee in 1989 at CERN some twenty years after TCP/IP v4 came into public use. In its early iterations, the WWW was a document

handling service using the TCP/IP v4 standard. Terms such as web ‘pages’ and ‘documents’ which were terms common in printing were used to describe the parts of the WWW. However, as the WWW grew, it became more divergent in the services that it enabled laying the groundwork for online collaboration. As stated by Gillies and Cailliau (2000):

The World Wide Web is like an encyclopaedia, a telephone directory, a record collection, a video shop, and Speakers Corner all rolled into one and accessible through any computer. (Gillies and Cailliau, 2000, p. 1)

The first major services that were provided for WWW users were search engines which are today dominated by *Google* and *Yahoo!*. Search engine services took over a decade to mature and were a stimulus for the sophisticated sharing and collaborative systems that are used today. However, online collaboration remained in an experimental and rhetorical stage until 1995.

In 1995 came the release of *classmate.com* which was one of the first social networking or so called Web 2.0 services (O’Reilly, 2005). *Classmate.com* was followed by others, until in 2005 when *MySpace* and *FaceBook* began to dominate. On the Internet, both *MySpace* and *FaceBook* as Web 2.0 social networking services along with *Google* and *YouTube* dominated Internet usage, according to Meeker and Joseph (2006) from Morgan Stanley.

In addition, today we are seeing new integrated productivity web based services such as *Zoho*, *ThinkFree*, *GoogleApps*, *eyeOS* and *SuiteTwo*, to name but a few, which are making online collaboration more available and more functional for productivity purposes and especially for education. These services are known as Software as a Service (SaaS) applications which enable collaborative sharing and interaction between individuals and groups of individuals.

The rise in the use of SaaS on the WWW since 2001 has seen rapid diffusion, which has also been reflected in education and ICT globally. For example, today the most used web based technology applications in education are *Google*, *Wikipedia* and online collaboration services such as instant messaging (IM). The take up of social

networking services and SaaS are important to this research as they have reflected in part the more recent take up of ICT in education through the uses of online collaboration.

Summary of discussion of collaboration

Collaboration occurs when people with different talents, skills and roles come together spontaneously to create value regardless of geography (Rosen, 2007). Creating value, in Rosen's definition of collaboration is a dynamic process of working together sharing physical and virtual space. This is an important concept in the digital world because it takes into account both physical and virtual communities. However, in education the culture of the teaching profession is collaborative and teachers as professionals learn collaboratively (Timperley, 2007) and can be spontaneous or planned. Collaboration in education is a process which involves leadership, community and sharing in physical or virtual spaces (Monteil-Overall, 2005). Collaboration has been defined here as *a process for the co-creation of knowledge while sharing physical or virtual space* where communities of co-creators share, explore and create knowledge.

Since 2001, with the rapid rise of online collaboration enabled by the Internet and social networking SaaS services, collaboration services in virtual communities have emerged to become professional meeting places for teachers. The role of collaboration in physical and virtual communities and their levels of influence can be judged using Education.au's list of ten characteristics of collaboration. The presence and strength of each can be assessed by examining the records of the governance, development and growth of EdNA to give an indication of the role that collaboration has had with the take up of EdNA.

Overview of literature search

Roger's (2003) theory of diffusion of innovation indicated the individual stages of adoption of an innovation, as well as the categories of adopters over time. While

innovators and early adopters usually take up an innovation before others, categories of adopters such as the late majority may take some time. These general conclusions of Rogers (2003) are not specific to education. However, his emphasis on the central role of communication channels in the context of the social system provides a clear pointer to ways in which his theory can be made more relevant to the diffusion of innovation *in education*.

It has been argued here that, in education the collaborative culture of professional development of teachers plays a significant role in the time taken to adopt an innovation such as ICT in education and also its success. Influential leaders working closely with change agents provide models of good practice using and modifying the innovation for their own use so that teachers can discuss and explore the innovation with colleagues. As the innovation is being explored by adopters working with innovators and early adopters the characteristics of an innovation explained by Rogers (2003) become important to identify the potential success or failure of the take up of an innovation.

The characteristics of the innovation, the rate and stages of adoption, and the adoption of the innovation over time can be gauged by examining EdNA's documentation and take up statistics, analysing the characteristics of the innovations for their likely adoption and then measuring the time taken to engage and implement the innovation. However, the communication of the innovation among teachers in a collaborative educational environment was also examined to determine the role that collaboration can have on the relative adoption of the innovation because that is the context in which the innovation took place. Eleven characteristics of collaboration were identified for further examination in the take up of EdNA.

This review has argued that the likelihood of adopting an innovation can be assessed by analysing the attributes of the innovation, focussed in particular on the attributes as facilitators of successful adoption or barriers to adoption. Further, following Rogers (2003) theory suggests that the diffusion of innovation of ICT in education goes through a series of stages (knowledge, persuasion, decision-making and confirmation) and its rate of adoption follows an S-shaped population curve. In addition, building on Rogers (2003) emphasis on the communication system and

social system, and heeding the research demonstrating that, in the context of education, this review has concluded that the concept of collaboration is of fundamental importance to any emerging theory of diffusion of ICT innovation in education.

Three components have emerged as fundamental to the theory of diffusion of ICT in education developed here:

- The attributes of the ICT innovation.
- The rate of adoption of the innovation.
- The role of collaboration that was evident in the development and adoption processes.

A theory of ICT innovation in education

The review has thus led to the formulation of the following theoretical proposition.

The successful diffusion of an ICT innovation in education can be assessed by its antecedents, its rate of population take up and the strength of collaboration associated with its development and use.

This theoretical proposition was put to the test in ways described in the remaining chapters of this thesis.

Chapter 4 Research methodology

Purpose

As indicated in Chapter 1, the overall purpose of this research was to advance an understanding of the diffusion of ICT in education, through the building and testing of a theory. The study overall was guided by four research questions:

The four research questions were:

1. How do theories of diffusion of innovations (e.g. Rogers, 2003) and frameworks for collaboration (e.g. Rosen, 2007; Education.au Limited, 2004a) inform the development of theory on the diffusion of ICT in education?
2. How does the application of this emerging theory to a case study of EdNA assist understanding of the critical success factors and barriers in the diffusion of ICT in education and further inform the development of the theory?
3. To what extent does collaboration appear to be a critical success factor or otherwise?
4. What are the implications of these findings for educational policy, planning and good practice?

Three sources of data were used to inform answers to these research questions and details of each of these are provided in the following section. There were:

- evidence from documentation of meetings, reports, press releases and information distributions
- the perceptions of key players, obtained from interviews

- the recollections of the researcher, who held a privileged position as the Chief Executive Officer (CEO) of Education.au Limited from 1997 to 2006.

The chapter then goes on to provide details of the approach taken to achieve the purpose of the study and answer the research questions. As indicated in Chapter 1, in a methodological sense, there were three separate but related phases of this study: an initial phase during which the chronological history of EdNA was researched and documented, then two subsequent phases – theory-building and theory-testing – which drew on the chronology. The phases of building the chronology and the theory have already been described in detail in Chapters 2 and 3 respectively. Hence, while this present chapter provides, in the first section, details of the data which informed the study as a whole, the major part of this chapter is dedicated to a discussion of the methodology for theory-testing.

Data sources

The research was undertaken using a case study approach because this methodology lent itself to capturing both the finely grained qualitative and broad-brush quantitative information. Creswell (2007) supports selection of case study as a method of research by suggesting that 'Case studies are best suited for developing an in-depth description and analysis of a case' (Creswell, 2007, p. 78) and also for 'Using multiple sources, such as interviews, observations, documents, artifacts (Creswell, 2007, p. 79). Coleman and Briggs (2003) provide a detailed definition of an educational case study as an 'Empirical enquiry ... such that sufficient data are collected for the researcher to be able ... to explore significant features of the case' (Coleman and Briggs, 2003, p. 109). A case study also enables a researcher as the writer to construct reality. As Richardson (2003) states, 'Writing as a method of inquiry, then, provides a research practice through which we can investigate how we construct the world, ourselves and others' (Richardson, 2003, p. 500). This study was best achieved using case study methodology which took into account the context of a phenomena (Coleman and Briggs, 2003), in this case EdNA, taking into account multiple sources of information for further analysis.

The case study approach accommodated investigation of the physical data generated about the use of the EdNA services and the actual documented recordings of press releases, meetings and reports, and related them to the recollections of some of the key players as well as the researcher. The physical data of EdNA server statistics for usage was generated from the EdNA server logs from November, 2000, to July, 2009. It also enabled a theory developed from the literature to be tested against a rich fabric of evidence from data bases, records, observations, reflections, recollections and commentary on which to test the theory.

Questions about the validity and reliability of the data that were collected and used in this research were addressed throughout the study. Validity here is taken here to mean that, 'A test is valid if it really measures what it purports to measure' (Scriven, 1981) and reliability refers to the consistency of the findings by researchers using the same data (Scriven, 1981). Yin (2003) and Mertens (2005) both support this notion of validity but Yin (2003) goes further and argues that construct validity is about 'establishing correct operational measures for the constructs being studied' (Yin, 2003, p. 34). It is noteworthy that the type of field work undertaken in this study is regarded as valid by many researchers including, for example Babbie (2001) who stated:

Field research seems to provide measures with greater validity than do survey and experimental measures which are often criticized as superficial and not really valid. (Babbie, 2001, p. 298)

Creswell (2007) adds to validity by stating:

Substantive validation means understanding one's own understandings of the topic, understandings derived from other sources, and the documentation of this process in the written study. Self reflection contributes to the validation of the work. (Creswell 2007, p. 206).

The recollections of the author who was involved in the development and management of EdNA have been included in this study where those recollections are supported by other information or documented evidence.

Yin (2003) goes further and suggests that construct validity requires the researcher to 'state the specific types of changes that are to be studied' (Yin, 2003, p. 35) and then to 'demonstrate that the selected measures of these changes reflect ... the specific types of change that have been selected'. (p. 35). This study is about the take up of EdNA and the role that collaboration in that take up. The take up has been measured by the actual server statistics of accesses and the collaborative aspects by the characteristics of collaboration that were evident and the levels of influence of the decisions, as well as the first hand perspectives of collaboration from a number of key players who were interviewed. The types of changes have been stated as the purpose of this study and the measures that have been selected do reflect the types of changes, in this case the take up of EdNA and the role of collaboration, further strengthening the validity of this study.

Reliability states Yin (2003) demonstrates 'that the operations of a study-such as the data collection procedures-can be repeated, with the same results (Yin, 2003, p. 34). The reliability of this research was enhanced by the triangulation of the data where the information from the documents has been supported by perspectives from the interviewees and also the recollections of the researcher. The data that has been used can be trusted because it has been directly sourced from the primary documents or has been based on comparative evaluations and recollections from the perspectives of the interviewees and the researcher. This research process is compelling because it is a firsthand account of a number of perspectives of collaboration, close to the time that it occurred, together with the actual statistical take up of EdNA. Further, the take up data has been triangulated to minimise bias. This study is timely because future research about the take up of EdNA would need to use the same data and information sets sometime in the future with the possibility of risking a distortion of perspectives and recollections through the elapse of time.

Documentary evidence

The information about EdNA was collected from primary document sources of the work of the Commonwealth, national committees and the governing body of EdNA

engaged in the development and management of the EdNA initiative. The document sources that were searched were quite extensive and included press releases, reports, records of meetings, papers and information from the Commonwealth, the Ministerial Council for Employment, Education and Youth Affairs (MCEETYA) and its ICT Schools Taskforce, the Australian ICT in Education Committee (AICTEC), the Flexible Learning Advisory Group, the Board of Education.au Limited and company operations, and the more recent EdNA Reference Committee. They were examined to note and analyse the attributes of innovation of EdNA's development and the decision level of influence, the take up of EdNA and the characteristics that were evident to identify and illuminate the role of collaboration.

MCEETYA was the most senior decision making body on national education and training issues, and policies which included EdNA. MCEETYA, which comprised the Education and Training Ministers from the Commonwealth Government and all State Governments met annually as a rule although in some years MCEETYA met more often. Decisions of MCEETYA were implemented through regular meetings of the Australian Education System Officials Committee of State Directors-General, Chief Executives and Departmental Secretaries. AICTEC and the Education.au Board reported to MCEETYA. The MCEETYA ICT Schools Taskforce also reported to AICTEC as did FLAG. The EdNA Reference Group reported to the Education.au Limited Board⁶.

In addition to the above records of meetings and reports, a number of papers and presentations were scrutinised for references to decisions affecting the initial negotiations and planning for the development and growth of EdNA. The papers and presentations were found from a number of Internet sources including the Education.au website archives, Google (2009) and Google Scholar (2009), and Link (Barry, 2009) the email discussion list archives as well as journals and theses.

⁶ In the course of the development and growth of EdNA, there were two separate groups that were both, at different times, called the EdNA Reference Committee. The first was AICTEC which was known as the EdNA Reference Committee from 1996 until 2001 and the second, which began in 2001 was a consultative Education.au committee that reported to the Education.au Board about EdNA and has continued to the present.

In the first years of EdNA, meeting documents were distributed by fax to participants. However, with the intense work of a new national initiative and rigorous timetables and deadlines, often several similar documents, each at different stages of completion, were sent on separate days. An example, is the fax to members of the NBRRG when the *Development of a Business Plan for Education Network Australia: An Issues Paper* (DEET, 1995b, 1995c) was sent on July, 14, 1995 and another on July 24, 2005. In the latter document new items 33 and 34 had been added, so although the two documents appeared the same and bore the same title, they were different. This meant that sourcing final documents often required painstaking searching and checking, and the document records did contain some inconsistencies.

Documents searches, limited to EdNA, were allowed by Education.au, AICTEC and MCEETYA although each of the collections was not a complete record of the events relating to EdNA. In order to obtain a more complete archival record of EdNA's development, growth and management, the documents from a range of bodies were searched and a timeline constructed. This also revealed some minor inconsistencies in the events recorded relating to EdNA.

The attributes of innovation were noted for frequency throughout the documentation as well as the levels at which decisions were made that affected take up and collaboration. The data on the take up of EdNA and its services were sourced directly from the EdNA servers and tabulated from the first recorded data about resources added to the service in 1998 and then to server accesses from the year 2000 until July, 2009.

Perceptions of key players

The perceptions of six key players engaged in the initiation, development or management of the EdNA initiative were sought. The key players were selected from a list of people who had been or remained engaged with the EdNA initiative at a variety of levels and who were currently available. Three actually worked on EdNA covering the whole period: one (Respondent A) who worked on EdNA until recently,

another (Respondent B) worked on EdNA as implementation began and a third worked on EdNA at the initiation phase (Respondent C). There was one (Respondent D) from the Commonwealth, another (Respondent E) was from a State, and the sixth (Respondent F) was a member of the EdNA governing body. These six interviewees were selected because they covered the governance of EdNA as well as the detailed innovation and development of new EdNA services. The six key players who were selected covered the whole period under investigation from 1993 to 2009. Their views have been included where it is appropriate to triangulate the evidence from other sources.

Prior to each interview, the interviewee was given brief background information (see Appendix 2) listing the attributes of innovation, a definition of and the characteristics of collaboration used in the study and the five phases of EdNA. The interviews took place either face to face or by telephone and each respondent was asked to reflect and comment on eleven questions (see Appendix 2) about the five phases of EdNA and the collaboration that took place at each phase.

The structured interviews were noted in a Livescribe pad and recorded using a Pulse Smartpen. Audio playback was available through the Smartpen. The notes and recordings from each interview were then uploaded to a computer using Livescribe desktop software, so that the notes were available visually and the recordings audibly accessible. Each of the interviews was then transcribed into text and stored on a memory stick that can be accessed through the researcher.

Recollections of the researcher

The researcher was the Chief Executive Officer (CEO), from 1997 until 2006, of the national education technology agency, Education.au, responsible for the development and management of EdNA and had been involved in the development of EdNA policies and direction since 1995 when EdNA was first mooted. From 1995 to 1997 the researcher was a member of EdNA consultative committees and then as CEO of Education.au from 1997 to 2006, the researcher was responsible for the management of EdNA and involved with AICTEC, the sectoral Advisory Groups and Working

Parties associated with EdNA. Prior to 1997, the researcher was engaged with the initiation of EdNA as a member of the EdNA Network Business Requirements Reference Groups and its Expert Working Party, consultations with the States about the business requirements of EdNA and the Reception Infrastructure Working Party. In these roles, the researcher was engaged in and witnessed firsthand the EdNA developments that took place from 1995 until 2006. From this perspective, the account in this research of the initiation, governance, development and management of EdNA is unique. In this way evidence from three reliable sources was included when considering the antecedents of EdNA, its take up and the role of collaboration

Methodology for development of chronological history of EdNA

The chronological history of EdNA in Chapter 2, began with an examination of the global and local environment in which computers were used in education prior to the invention of the WWW. This was then followed by a brief discussion of the WWW and then the reactions of some education bodies around the globe, as well as events in Australia. The national policy response in Australia to the capacity of the WWW as it led to the initiation of EdNA was also outlined. The initiation of EdNA in 1995, consultations with the States on the business requirements for an EdNA service and then EdNA's development, implementation, and management were documented chronologically. This unique study of EdNA followed its five developmental periods, setting the scene for a more detailed investigation of the likelihood of success, its take up and the role of collaboration.

The documents that were examined were records of press releases, meetings, reports, planning documents and consultation papers for comment by the States on the business requirements of EdNA. They were primary information sources from the EdNA Network Business Requirements Reference Group (later to become the ERC and then AICTEC) and its Expert Working Party, the Reception Infrastructure Working Party, the three sectoral Advisory Groups, the working parties for telecommunications, standards and commercial materials, and the Board of Education.au as well as its subsidiary groups, especially the ERC. A number of

archives such as press releases from the Australian and discussion/news services such as the Link online discussion archive were also searched. From these sources, a timeline of events was constructed on which the five phases of EdNA emerged.

Methodology for theory building

The literature on the diffusion of innovations was reviewed with the work of Rogers (2003) being dominant but supplemented by the work of others such as Wilson et al (2000). The antecedents of innovation and the take up of an innovation became important elements of the study because of their robustness and applicability. However in education, the communication and social systems have been argued to occur within a collaborative educational context. The nature and role collaboration were therefore examined in the literature and a new definition of collaboration for education developed for use in this study.

The literature review of the diffusion of innovations and the literature review of collaboration in the educational context led, as seen in Chapter 3, to the proposal of a new theory of the diffusion of ICT in education. This theoretical proposition was then tested in the remaining chapters of this thesis.

Methodology for theory testing

The analysis in Chapter 3, revealed three components as fundamental to the development and testing of a theory in relation to the diffusion of ICT in education. Contextualising these components in terms of EdNA, the following were important to the data collection and analysis for the theory-testing phase of this study:

- The attributes or antecedents of EdNA
- The rate of adoption of EdNA
- The role of collaboration that was evident in the adoption process

Further, building on the stated proposition at the conclusion of Chapter 3, the position of this study was that the likelihood of successful adoption of EdNA could be estimated by:

- the levels of influence for each of the antecedents
- the take up of EdNA particularly in terms of whether it followed an S-shaped curve, and the gradient of that curve, and
- the role of collaboration in the take up of EdNA.

Theory testing: data collection and analysis

The chronological description of the EdNA initiative for this research, namely, development, growth and take up of Education Network Australia (EdNA) was detailed in Chapter 2. Given that collaboration amongst stakeholders was of fundamental importance to the establishment of EdNA, this research examined, in particular, the role of collaboration in the diffusion of digital technologies by education systems for teaching and learning, using EdNA as the case study. This was done by examining the attributes of innovation as the antecedents for EdNA and the level of influence of each attribute, followed by tabulating and graphing EdNA's take up using collected web statistics from the EdNA servers and then finally, by examining collaboration and its characteristics as well as the levels of influence for each phase of EdNA's growth and development. The levels of influence further highlighted the role of collaboration and other related processes such as cooperation, coordination and networking.

Attributes of an innovation (Antecedents)

The attributes of an innovation that were used included the following developed by Rogers (2003):

- The *relative advantage* of an innovation is the degree to which an innovation is perceived as better than the idea it supersedes.

- *Compatibility* is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters.
 - *Complexity* is the degree to which an innovation is perceived as difficult to understand and use.
 - *Trialability* is the degree to which an innovation may be experimented with on a limited basis.
 - *Observability* is the degree to which the results of an innovation are visible to others.
- Rogers (2003, pp. 15-16)

For the purposes of this research, two more attributes were added. Wilson et al (2000) included *support* as a key attribute of innovation when researching adoption of learning technologies in schools and universities. Support in the context of innovation in education includes encouragement by leadership and authority, valuing of the efforts of innovators, sharing successes and challenges with a view to seeking best practice, and timely technical support when needed (Wilson et al, 2000). Further diffusion research (Rogers, 2003) added the concept of *reinvention* or *modification* as an attribute of innovation. Rogers (2003) defined the concept of reinvention as the degree to which an innovation is changed or modified by a user in the process of adoption and implementation. The concept of reinvention is an important attribute of an innovation because Rogers (2003) argues that an innovation diffuses more rapidly when it can be reinvented and that its adoption is more likely to be sustained. The above attributes of an innovation show six that can be described as success indicators. They are: 'relative advantage', 'compatibility', 'trialability', 'observability', 'support' and 'reinvention'. There is also one attribute of innovation, 'complexity', that indicates a barrier to the successful adoption of an innovation. The combined seven attributes of innovation used in this study were:

- *relative advantage*
- *compatibility*
- *trialability*
- *observability*
- *complexity*
- *support* and

- *modification or reinvention.*

The method that was used in this study to examine Rogers’ (2003) antecedents as success indicators and barriers was to construct a four-point scale indicating the levels of influence of each attribute as found in the documentation. The four-point scale that was used as described in detail below.

A description of the recorded entries of each attribute (*relative advantage, compatibility, complexity, trialability, observability, support, reinvention or modification*) was evaluated by the four ‘levels of influence’ for each attribute. The levels of influence took into account the decision making powers of a range of bodies. The first or highest level of decision making was that of the national Ministerial Council (MCEETYA), the second level was that of nationally aggregated and separate sector bodies (AICTEC, ICT T/F and FLAG), the third level of influence were company bodies (company Board and ERC) and finally an antecedent not mentioned in the documentation was marked as ‘absent’. These four levels have been numbered as 1-Ministerial, 2-national, 3-company and 4-absent in the Table 4.1.

	Rel.- adv.	Compat -ability	Complex -ity	Trial- ability	Observ- ability	Support	Modify
1-Ministerial							
2-National							
3-Company							
4-Absent							

Table 4.1: Levels of influence of innovation attributes

In Table 4.1 above, the indicators of success and barriers to adoption can be gauged, for each innovation attribute or antecedent by its level of influence based on the decision making levels. The levels of influence, which gave an indication of the likelihood of success of innovation adoption, were judged by references, actions, decisions and approvals found in the documentation.

Rate of adoption of EdNA

The rate of adoption has been explained at some length in the previous chapter and is integral to the theory above. It refers to the adoption or take up of an innovation by the percentages of the population involved in the innovation, over time. Rogers (2003) has described five categories of adopters which can be graphically depicted: *innovators*, *early adopters*, *early majority*, *late majority* and *laggards*, as shown in Figure 4.1. The S-shaped curve of the rate of adoption or take up is integral to the understanding of the adoption of innovation because it is through this curve, or graph of the take up of ICT, that the role of collaboration, by examining its characteristics, can be identified and explored.

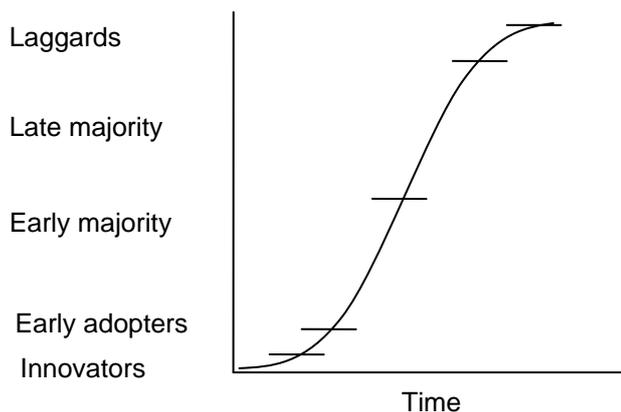


Figure 4.1 Rate of adoption: Adopter categories over time (Rogers, 2003)

In this research, the rate of adoption of EdNA over time was based on the statistics of the take up of EdNA. The S-shaped curve of adoption was important to this research as it highlighted the points where changes in take up occurred as areas for possible further investigation of the characteristics of collaboration and the rate at which take up occurred.

(i) Measurement and take up

A review of the complex area of web statistics is in order before considering EdNA's usage statistics. This has been done in order to clarify the web measurement terms that have been used and to understand what they mean, so that the graphs of EdNA's usage can be seen to be reliable and robust.

Web measurement

Interest in web analytics and measurement began in 1993, according to the Web Analytics Association (WAA, 2009), when a product called WebTrends was initiated. The official WAA definition of web analytics reads:

Web Analytics is the measurement, collection, analysis and reporting of Internet data for the purposes of understanding and optimizing Web usage.
(WAA, 2009)

The WAA definition uses two terms of interest: 'web analytics' and 'measurement'. Peterson (2005) makes a distinction between 'web analytics' and 'measurement' when he argues that web analytics is 'the act of interpreting measurement reports so that organizations can take some action' (Peterson, 2005). Web measurement, on the other hand states Peterson 'is that act of collecting data and parsing it into a useful and human-readable form (e.g. reports)' (Peterson, 2005, p. 3). Web measurement is a more accurate term for the purposes of this research because it is about the collection of data on the take up of EdNA and then organising that data into meaningful information in order to help understand the diffusion of EdNA.

So what data is useful in the context of this research which is seeking to find a pattern of take up based on consistent and accurate data? Firstly, there is a need to consider the terms that are commonly used in web measurement: hits, page-views, visitors and unique visitors. A 'hit' is used to mean an electronic request for a file of any type from a web server (Peterson, 2005). When a web page is downloaded, the number of hits depends on the number of files embedded in the web page and

recorded in the log-file on the web server. However, a redesign of a web page will change the number of hits recorded in the log-file because the number of files requested changes in order to load a complete web page. The use of hits to record accesses to web pages is regarded in the industry as misleading and inaccurate (Croll, 2009; Peterson, 2005).

More reliable terms such as page-views, visits and unique visitors are used to measure the popularity of websites indicating their usage. A 'page-view' is recorded by a page request from a web browser for the files that make up a web page (Croll, 2009). Although page-views are regarded as more reliable, they are based on a number of assumptions about the browser requests. For example, after a period of 30 minutes of inactivity, the session is deemed to have expired, so tracking the number of page-views is difficult. Another example would be repeated page visits by the same visitor. However, page-views are consistent and reliable data. A 'visit', on the other hand, records a collection of pages accessed by a browser and an 'unique visitor' is identified by a unique identifier from the browser. Both a 'visit' and an 'unique visitor' are based also on a number of assumptions and can be ambiguous but are regarded as more accurate than hits (Peterson, 2005).

This research is focussed on the diffusion of EdNA as a web service, so a consistent set of data was needed and the pattern that emerged from an examination of that data was sought. For the purposes of this research a collected page-view has been used as the unit of measurement in order to establish a pattern of take up. Page-views of EdNA were collected and published from September 2000 onwards and are both reliable and consistent for EdNA.

Graphing take up

In order to graph the take up of EdNA, page-views were tabulated and then graphed showing the elements of an S-shaped curve. These graphs of the take up statistics gave an indication of the rate of adoption of EdNA for user populations as well as an indication of peak usage periods. The critical stages of peak usage on the rate of adoption curve could be related to activities that were being undertaken at or leading

to that time, from the documentation. The rate of adoption graphs were completed to demonstrate consistency with Rogers (2003) theory of diffusion of technology innovation although in education that theory has been extended in this research to include collaboration.

Role of collaboration

The characteristics of collaboration, identified to in the previous chapter, comprise:

- *shared leadership*
- *goals*
- *processes*
- *decision making*
- *change, intelligence*
- *flexibility*
- *communication,*
- *diversity in thinking* (Education.au Limited, 2004a) and
- *appropriate level of technical competence* (Clark, 2008).

These characteristics or attributes can also be evaluated by the presence or absence of each in the documentation, and how decisions and actions were taken. The curve of the rate of adoption indicated the time for adoption of the innovation and also nominated the percentage of population that adopted ICT, in the case EdNA. The role of collaboration can be seen and explored at those points on the curve that correspond to peak usage and were related to the time scale of adoption, as described in the EdNA chronological history. The exploration of collaboration at these critical peak usage points on the graph of the take up of EdNA demonstrated indicators of success and barriers to adoption.

Collaboration prior to the year 2000 was judged in the documentation by its characteristics and related to the levels of influence. After 2000, the rate of adoption of EdNA, graphically displayed using page-view statistics, gave an indication of the

peak usage periods for EdNA. The peak periods and the events leading to each were examined for the characteristics of collaboration as they related to EdNA 's development, growth and management, from 2000 when reliable statistics were kept. Collaboration was examined during the five major periods of EdNA, building on the EdNA chronology from Chapter 2. The five phases were:

- The initiation phase 1995 to 1997
- A directory service of evaluated resources 1996 - 2009
- Shared Information Services 1996 - 2004, 2005 -2009
- Group collaborative services 2004 - 2009, and
- Personalised services 2007 – 2009.

The characteristics of collaboration in each of the five phases and for the peak periods arising from the graphs of page-views were interpreted from the documentation. At each phase, the levels of influence were also considered because there would appear to be a relationship between collaboration and the levels of influence. A number of EdNA initiatives that were not successful were also analysed from the perspective of collaboration and its characteristics, as well as the levels of influence for those activities, in order to further elucidate the role of collaboration in diffusion. In this way, the critical success indicators and barriers to adoption were highlighted together with the role of collaboration.

Summary of research methodology

This chapter has described how this research built and tested a new theory of diffusion of ICT in education beginning with the development of a framework to guide that task. The framework for testing the new theory had three parts. Firstly, the attributes of innovation were used as antecedents to gauge the likelihood of the success of EdNA. The levels of influence involved in the antecedents were also considered. This process gave some indication of the success indicators and barriers to success. Then graphs of the quantity of content loaded onto EdNA were discussed followed by graphs of the take up of EdNA, for the period 2000 to 2009, when reliable web access statistics were collected.

During the five phases of EdNA's development, collaboration and its attributes were examined along with the levels of influence that occurred at each phase. Through this process, evidence was assembled about the critical success indicators and barriers to adoption which gave an indication of the role of collaboration, for the period under investigation.

The next three chapters present the findings of this theory-testing, with Chapter 5 examining the attributes or antecedents of EdNA as an ICT innovation and the likelihood of its take up. This is then followed in Chapter 6 by graphs of the actual take up of EdNA using EdNA's page-view access server statistics. The graphs of EdNA's take up also indicate the peak periods of EdNA usage. These peak periods were examined in Chapter 7 together with the phases of EdNA's development for evidence of collaboration and the levels of influence at each phase.

Chapter 5 Testing the Theory: Antecedents (1995-1997)

Purpose and outline of the chapter

As indicated in the previous chapters, this research was underpinned by the proposition that, to judge the success of the diffusion of an ICT innovation in education, three aspects of an innovation need to be examined: the antecedents, the rate of adoption and the role of collaboration. This chapter focussed on the first of these. Its purpose was to present an analysis of the antecedents from the chronological history of the innovation (EdNA) in accordance with the attributes of an innovation derived from Rogers' (2003) and Wilson's et al (2000) work. Essentially, these antecedents are factors that have been shown by previous research to be present consistently in the early stages of the successful diffusion of an innovation (Rogers, 2003). The seven factors identified and applied in this case study of EdNA were:

- Relative advantage
- Compatibility
- Trialability
- Observability
- Complexity
- Support, and
- Modification or reinvention.

The period of interest to this analysis spans from April, 1995 when the decision was made to establish EdNA until November, 1997, when the service was officially launched – essentially the establishment period of EdNA. As outlined in Chapter 4, the analysis involved the triangulation of data from three sources – background documents and reports, information from key participants and personal recollections. This chapter treated each of these antecedents in turn, commenting on the extent to

which they appeared to have operated as indicators of success or barriers to the take-up of EdNA.

Analysis of antecedents - likelihood of success or barriers to success of EdNA

Each of the seven antecedents of EdNA are discussed below.

Relative advantage

The first antecedent 'relative advantage' can be described as the degree to which the innovation was perceived as better than the idea it superseded. In the case of EdNA, there had been no previous national online service that enabled educators to access digital resources. As one interviewee said:

We never had any arguments about EdNA being national. EdNA was something new. We were starting from scratch. (Respondent F)

This was succinctly reinforced by another respondent who said simply:

I sort of (sic) expected it (EdNA) to be successful in the early years [because] there was nothing else around. Basically, it was the only means for the take up of ICT in the education sector. (Respondent C)

There was seen to be a relative advantage in coordinating access to online information resources for mutual benefit. Arthur, (1995) as early as July, 1995, when the initiative was being established, spoke at the Australian Computers in Education Conference in Perth and stated:

Education Network Australia (EdNA), ... will deliver educational services and products across the nation and contain the costs of accessing interactive information networks for education users. Some schools and school systems are in the early stages of experimenting with the possibilities offered by networking.

However, initiatives are often being undertaken in isolation, without any awareness of other, closely related activities. (Arthur, 1995, p. 1)

Gibbons (1995a) went further in December, 1995, when speaking to the Canberra Managers Forum of the Australian Internet Industry Association by stating that, 'there is also a great deal of duplication of effort and reinvention of the wheel going on' (Gibbons, 1995a). Gibbons (1995a) was referring to the efforts of the States, doing almost the same things but doing so in ways that could in time lead to incompatible approaches restricting the capacity to share and reuse resources.

The stakeholders, being the States, the Commonwealth, Independent and Catholic school systems, the training sector and the university sector, all of which were consulted about the requirements of the proposed EdNA service, engaged fully to develop the network business requirements for EdNA (DEET, 1995c). They did this from the commencement of the Network Business Requirements Reference Group (now known as AICTEC) in July, 1995 until agreement by MCEETYA Ministers in December, 1995 (MCEETYA, 1995c) when the network business requirements were approved. A beta service called the EdNA Interim Service was established by the DEETYA EdNA Networking Taskforce at the beginning of 1996 (Education Networking Taskforce, 1996) and outlined more fully at a consultative Technical Conference in March 1996 (DEETYA, 1996a). The plans for this Interim service were able to engage stakeholders in visions for the future of online Internet services in which they could share. In addition, an experimental prototype for experimenting with proposed changes suggested by members was established in May 1996 (DEETYA, 1996b) and continued until the then EdNA Reference Committee (now known as AICTEC) discontinued its use in January, 1997 (EdNA Reference Committee, 1997). This demonstrated a degree of flexibility in order to maintain a relative advantage for stakeholders by taking account of their expressed needs. This flexibility also underlined the goals of the project for collaboration and cooperation to contain costs and avoid duplication among stakeholders, and was a clear relative advantage.

The flexibility to maintain relative advantage as part of the EdNA initiative was demonstrated by the EdNA Network Business Requirements Reference Group

(DEETYA, 1996c) further when the Commonwealth's EdNA Networking Taskforce wrote a short paper *Future Development of the Education Network Australia Initiative*. The paper outlined several changes that had occurred to online services since the inception of the initiative and suggested that it change direction. As stated in the *Future Development of the Education Network Australia Initiative* paper,

The overall focus of the May 1995 decisions on EdNA was on the establishment of an actual network for the Australian education sector and on the services which such a network should provide. It is apparent that the focus should now be on arrangements to coordinate the use made of online services, particularly the Internet, in Australian education and on cooperative action, where appropriate, to overcome the barriers to the effective use of such services.

(DEETYA, 1996c, p. 2)

The initiative changed from developing a whole of education network including arrangements for telecommunications, to harnessing and coordinating online services using the Internet. This change occurred because the stakeholders (States) began to develop their own online services using the Internet such as SOFWeb in Victoria (Department of Education and Training, 2002) and State purchasing arrangements for the provision of government telecommunications services. The levels of influence were at the Ministerial level when the project was initiated and for the agreement of the business plan as well as nationally, led by the Commonwealth. The business plans for the EdNA initiative were flexible to meet the needs of the stakeholders and it appeared to provide a relative advantage to the States because each State sought agreement and sign-off from their State Minister who was a member of MCEETYA (DEET, 1995d). As a result the States maintained their interest in and support for the initiative. The flexibility of national consultations and collaboration were also a way to enable stakeholders to share in the progress of these new types of technologies and networking ventures.

Compatibility

The second antecedent 'compatibility' has been explained as the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. Compatibility was clearly present when the EdNA project was being instigated due to the extensive consultations that the DEET Education Networking Taskforce undertook to shape the project (DEET, 1995c).

In July 1995, Commonwealth officers initiated an around-Australia consultation on the needs of a national network service. Members of the DEET Education Networking Taskforce accompanied by members of the NBRRG Export Working Group, a group of four stakeholders each one a senior member of each education sector selected from the NBRRG, met with all stakeholders and education jurisdictions during the period from 1 July, 1995 through to September, 1995 (Gibbons, 1995b). The consultations discussed an issues paper, *Education Network Australia: Development of a Business Plan for Education Network Australia (EdNA): An Issues Paper* (DEET, 1995b) prepared by Commonwealth officers again leading from a high level of influence. The issues paper was adjusted on the basis of the feedback from the consultations which considered the needs and requirements of each State education system. The Commonwealth and the Expert Working Group then synthesised the results of the consultations for inclusion into the adjusted business paper for the NBRRG. In this way the National Network Business Plan included the needs of the education jurisdictions which were the stakeholders. When the complete business plan document was finalised, States agreed to take it to their Education and Training Ministers for 'sign-off' or final agreement by each State.

The compatibility of the plan was evident from a number of factors including the extensive national consultations, the many refinements made to the plan on the basis of consultative feedback, the synthesis of the States' requirements, agreement by the NBRRG and the agreement of each State through sign-off' by their most senior person of the collaborative document *Education Network Australia: Draft Business Requirements Analysis* (DEET, 1995d). As one interviewee stated:

We (Australia) were able to do this because we had pre-existing collaborative structures. We had all Ministers around a table together periodically determining directions and policy. (Respondent F)

The processes for national consultation were both compatible and inclusive of State, Catholic and Independent schools (DEET, 1995d). There already existed collaborative Federal structures for national education work involving the Commonwealth and the States for school, VET and higher education issues although each sector had separate structures. The consultations about EdNA involved the three sectors working together.

Trialability

Rogers (2003) argued that trialability was a significant antecedent for successful diffusion of innovation. He stated that, 'trialability is the degree to which an innovation may be experimented with on a limited basis' (Rogers, 2003, p. 16). The EdNA initiative was a national Australian collaborative education and training project, and as has been mentioned above, it was highly complex both technically and as a new endeavour. The EdNA initiative occurred in a technological space that was new to educators and knowledge in the field of ICT in education was rare. As a result the likelihood of EdNA trials in the States, on a similar scale to the national initiative were remote because the States did not have the expertise or the knowledge.

The technical development of the EdNA Interim service was established by the Commonwealth Government's Education Networking Taskforce (Education Networking Taskforce, 1996) through consultation with stakeholders to gain advice on agreed functionality for the service and also by employing a contractor to undertake the technical developmental work. The 'beta' service was demonstrated to members of the NBRRG in January, 1996, (DEET, 1996a) and progress was discussed in more detail by stakeholders at the two-day Technical Conference held in March 1996 (DEETYA, 1996a). During those discussions stakeholders saw demonstrations of the EdNA Interim service in a prototype environment and had the

opportunity to make suggestions or comments for adjustments and changes (DEETYA, 1996b). There was a need for a prototype service where trials of functionality by stakeholders could take place. However, these trials were limited to a controlled environment and administrative access was restricted. The effort to trial was led by the Commonwealth and was more focussed on engaging the stakeholders than on trialling the EdNA Interim service even though one report stated that a number of schools would be working on online projects by the end of the year (DEETYA, 1996c). In this way, expectations for trialling the use of the service were understood although at that stage teachers were not big users of online services and needed encouragement. As one interviewee stated, 'The marketing of EdNA to users was a critical factor in the success of take up'. (Respondent B), although as another stated there were:

strong expectations that take up would be high but the exact ways that education would collaborate and how they would use it and take it on board in practice was probably unknown in those in the early days. (Respondent A)

Observability

Observability in relation to the diffusion of an innovation is the degree to which the results of an innovation are visible to others. EdNA, as an electronic Internet service, was observable on a computer screen but the direct progress of the EdNA service was only viewable initially by the developers and the Commonwealth Officers (DEET, 1996a). This meant that those from the States involved in advising about the development of EdNA observed development progress from print-outs which was a different medium. Schools and VET sectoral sub-working groups were established to develop the EdNA Directory (DEET, 1996b) which culminated in a number of policy documents, of limited circulation, for agreement by the NBRRG. In this sense, progress was observable for the stakeholders involved. However, other than accessing the EdNA Interim Directory Service on a computer screen, if one was available, the service was difficult to observe and policies were almost inaccessible. Notwithstanding this, the Commonwealth level of influence was brought to bear nationally on the issues and as one interviewee said, 'there was strong take up at the

stakeholder level. There were strong connections with officials'. (Respondent A). Much of the early work, however, was focussed at the policy level.

The progress of the EdNA Directory service was communicated using print-outs of screen images of the service. A prime example was the report of EdNA's progress to Ministers (MCEETYA, 1995c) in December, 1995, when screen captures were printed as part of the papers for Ministers. Observability was difficult while both the use of computers in education and the Internet were new to education. Using the Internet in meetings was rare.

EdNA provided links to educational digital resources both within Australia and globally. The resources that were selected conformed to a set of criteria, previously referred to as content principles (EdNA, 2009). Although these were observable, again it was via a computer screen at a time when computers were large and cumbersome, often unavailable, and small mobile computers such as laptops were not yet commonly available (NSW Audit Office, 2000). For these reasons, the observability factor was and remained an issue to be overcome at all levels of education, for those involved in its development.

Complexity

The complexity of an innovation is the degree to which an innovation is perceived as difficult to understand and use. The EdNA project, initiated in 1995, was a new venture for education and training. Although the OLTC had been operating since 1993, its services were focussed on physical networking, developing technology projects, and a brokerage for education technology projects and information. The EdNA initiative was the first national Australian online service which used the WWW and there was some uncertainty about how events may unfold because it had not been done before and the skills were scarce, so caution and thoroughness were important. As one interviewee said:

The skills and expertise weren't available in any one State. The skills were with a small group and scattered. It was basically trial and error with everyone

getting together and trying to shape a service. Collaboration brought it together and basically it was a means of learning from each other which basically no-one had done before. (Respondent C)

This complexity of the EdNA service can be seen in the *Education Network Australia: Draft Business Requirements Analysis* (DEET, 1995d) document which was both complex and extensive. Knowledge about the Internet and its WWW service was not widely understood in mid-1995, when consultations about the document were undertaken, and the EdNA initiative can be seen as part of an educative process in itself for the stakeholders. However, the project was led at a high level of influence nationally by the Commonwealth with the agreement of Ministers and there was, as one interviewee suggested, 'commitment, focus, common goals and lot of excitement about it' (Respondent B).

The document *Education Network Australia: Draft Business Requirements Analysis* (DEET, 1995d) was extensive and comprehensive in discussing a number of concepts such as networking, the Internet, telecommunications and online security. These concepts were not usual topics for discussion among educators, trainers and academics, and so many of the stakeholders found themselves engaged in a steep learning curve, engaging with the fine granular detail in the documentation. Schools and training jurisdictions were beginning to connect their institutions to the Internet using the most basic means available (DEET, 1995d, p 43-49) which at that time was via dial-up telecommunications services. The analysis document was very detailed, highly complex and outside the normal range of expertise for most education and training jurisdictions. However, the NBRRG did include some university and Commonwealth experts as well as some elected experts who were knowledgeable in these areas of networking, the Internet, telecommunications and security, and who also could lead the discussions (DEETYA, 1997a).

Two other factors highlighted the complexity of the EdNA project in its establishment stages. The first has been mentioned previously and was the change from the development of:

An actual network for the Australian education sector and on the services which such a network should provide [to] coordinate the use made of online services, particularly the Internet. (DEETYA 1996c)

This move from establishing an actual Australian education network to coordinating online Internet services led to the preparation and distribution of a new document titled *Future Development of the Education Network Australia Initiative* (DEETYA, 1996c) for comment and discussion by the States adding further complexity to the project. In fact, a special two-day Technical Conference to explain the technical issues associated with coordinating online Internet services was hastily organised by the Commonwealth (DEETYA, 1996d). Confusion had arisen over the word 'network' which was understood by the State officials to mean 'a directory service or a physical infrastructure or a community of people' observed one interviewee. (Respondent D). This respondent was quite clear that:

They (the Commonwealth) shifted ... to a collaborative approach, to looking at what all the needs are (were) and to working at it over time collaboratively ... which was a big shock to some of them (the States)... the education systems ... because, particularly schools at the time, ... thought that EdNA would be all things to all people. (Respondent D)

The second factor was the inclusion of telecommunications issues in the *Education Network Australia: Draft Business Requirements Analysis* (DEET, 1995d) paper which had been under discussion then for five months. A paper was drafted on telecommunications titled *Education Network Australia-Telecommunications Requirements* (DEET, 1995e) which was to be used as a basis for consultations with telecommunications carriers. Telecommunication issues did require further specialist expertise to explain the issues to the State participants engaged in the EdNA initiative especially those involving digital services which were relatively new to the public landscape in Australia as well as being complex.

There were other factors which also increased the complexity of the EdNA initiative that became apparent when the EdNA Interim service was launched in January 1996. One of those involved the detailed emphasis that was given to the development of

content metadata, that is, structured information about content to enable retrieval. This specialist information work had begun in March, 1996, by the Schools Sector Group (DEETYA, 1996e) in which guidelines for five areas were agreed to be prepared. The Schools Sector Group required a good knowledge of metadata and publishing because the guidelines were about:

- Content standards
- Gathering and managing content
- Publishing
- Directory services, and
- Quality assurance.

Traditionally, the skills required for these areas could be found with teacher-librarians who were responsible in schools for managing information resources. The sectoral groups therefore sought these skills from their teacher-librarian and information management skilled members. This was reinforced by one interviewee who said that 'people with some knowledge and expertise were brought together to work out 'how services could be developed and shaped, [as well as] tools to manage it [information] and national policies and guidelines' (Respondent C).

When the interim EdNA service was launched in February, 1996, metadata was an important mechanism for ensuring that the quality of content retrieved on the EdNA Interim service was consistently high (Millea, 2003). However, the development of metadata was very complex and as the documentation attests, a handful of teacher-librarians on the EdNA Schools Working Party, carried the development of metadata forward while at the same time they explained the benefits of metadata to their colleague collaborators (Millea, 2003).

The complexity of the EdNA initiative can be summarised in three main points: the change from an actual network to collaboration about online Internet services, the work on telecommunications for consultation with industry and the development of metadata for the content to be searchable on EdNA. Detailed consideration of these issues was led by Commonwealth and university experts who explained the complexities of Internet services to the EdNA stakeholders through technical

conferences and print-outs of graphical user interfaces. The Commonwealth also engaged a team of Internet experts to undertake the technological development of EdNA. Both of these strategies were successful in establishing the EdNA initiative and in assisting the States to understand the potential of the Internet for their own jurisdictions.

Support

Support in the context of diffusion of innovation in education includes encouragement by leadership and authority, valuing of the efforts of innovators, sharing successes and challenges with a view to seeking best practice and timely technical support when needed (Wilson et al, 2000). EdNA was established by the Commonwealth and led by its officers who not only set up consultative committees but also acted as the secretariat, providing the executive functions, for the committees. The Commonwealth provided the initial funds for the establishment of EdNA and initially developed the EdNA Interim Service which became the EdNA Directory Service (DEET, 1996c).

From documentation and anecdotal evidence, it can be seen that the leadership and authority of the Commonwealth in establishing the service nationally was significant (DEET, 1995d). As the decision for EdNA was agreed by the education and training Ministers in MCEETYA, then EdNA also had the support of the Chief Executives of the State education systems because they were responsible to the Ministers. The EdNA initiative was supported at a high level of influence. In this way EdNA was supported by the highest levels in education and training, and participation was forthcoming from the States in enabling their officers to engage nationally although, as one interviewee said:

Some of those people met resistance when they went back to their organisations. A lot of it was strictly territorial and bureaucratic, and people questioning even the investment by their own systems and States in the national collaboration as to whether it was a waste of money because they wanted to use the money for something else. (Respondent E)

The collaborative nature of the venture provided a structure and platform for national sharing. In these ways the support, in the initial stages of the development of EdNA, could be argued to be strong at the very senior levels and by those engaged. However, as evidenced by the comments of the key stakeholders interviewed during this study, support for the initiative throughout the State education system bureaucracies was not necessarily as strong.

Modification or reinvention

Rogers (2003) defined the concept of reinvention as the degree to which an innovation is changed or modified by a user in the process of adoption and implementation. He argued that diffusion can be more rapid and its adoption more likely to be sustained when it can be re-invented (Rogers, 2003, p.17). EdNA was established as a project by the Commonwealth with national engagement from education authorities in the States and led in a consultative process. Through the support and consultative processes, EdNA was enabled to develop the functionality and content framework as it progressed, that is, EdNA was a work in progress. This continual modification and development of the functionality and accompanying policy development indicated a degree of modification which could have an impact on its use. An excellent example of this type of modification within EdNA was the development and agreement of the content guidelines (DEET, 1996d) announced by the Commonwealth following the collaborative work done by the schools, training and higher education sectors to develop criteria for accepting, approving and posting content on EdNA in the form of links, documents and resources materials.

However, this process of consultation and collaboration also served as an educative forum that provided the knowledge to enable States to build their own web-based online services. This was reflected in the comment of one interviewee who said that 'in the early stages of EdNA, [it] was replicated by many of the States. (Respondent A). These State services were almost in direct competition with EdNA as a reference service for online resources in education, even though the States had agreed to share resources and content with EdNA in a reciprocal arrangement as part

of the *Business Requirements Analysis* (DEET, 1995d). One such example of note was SOFWeb, mentioned previously, produced by the Department of Education in Victoria (Internet Archives, 2009) which began full operation early in 1998 although an interim service was available much earlier in 1995 (Department of Education and Training, 2002). SOFWeb included links to educational resources, administrative information and local online resources contributed by local users.

The educative value of the EdNA collaborative process had two roles. Firstly, it was a forum to enable States to learn about developing online services so that online services could be developed with ever increasing complexity, in their own States. Secondly, it was a factor that could render EdNA or parts of EdNA obsolete unless EdNA remained innovative and provided state-of-the-art services valued by its State stakeholders. When discussing the proliferation of information on the Internet and the popularity of Google, one interviewee remarked that, 'The Directory service (of EdNA) was slowly superseded as a device'. (Respondent F). If obsolescence was to become factor then EdNA had to constantly pursue innovation and reinvention for it to remain active and supported by the stakeholders nationally.

The notion of reinvention helped to understand EdNA when it was considered that it began as a web based directory service, then was re-invented as a news service followed by a search and browse service, then an email notification and distribution service, until today when it has become a combination of all four as well as a service for group discussion and personalisation (Education.au Limited, 2008d).

Summary of EdNA's likelihood of success, as indicated by antecedents

A number of issues became clear in the study of the antecedents. Firstly, EdNA had a clear relative advantage in that it was a pioneer activity for Australian education and the stakeholders were engaged in the collaborative national work to develop the policies, functionality, services that it could provide. The concept of EdNA engendered a high level of interest among educational leaders, especially in the capacity and potential for education to be able to use the Internet.

Secondly, the compatibility of EdNA with the needs of the States was part of the collaborative processes of regular consultation, feedback and adjustments of plans. Through consultation, the States were, to a large extent, given purpose and direction in the new service by the Commonwealth which led at a high level of national and Ministerial influence from which engagement and support were evident with regular progress reports to Ministers. This compatibility was aided by the fact that the national collaborative structures already existed but with a new project, such as EdNA, the normal Commonwealth and State rivalries were not evident. However, the cross sectoral nature of the collaboration, which gave rise to some tensions, was novel and provided valuable expertise and insights into developing the new EdNA service. The collaborative nature of the initiative and the absence of the usual Commonwealth-State rivalries meant that the compatibility of EdNA with State online education services was strong and sufficiently flexible to accommodate State education-system needs.

However, there were some antecedents that were not helpful. EdNA was a very complex, poorly understood and at times confusing new online service. It was one that was hard to observe, except through a computer screen, where educators had to have a connected computer to see what was happening. Educators also needed to know what the Internet could achieve to grasp the concept of sharing using EdNA. The complexity of developing policies without precedents in education was difficult and establishing digital metadata for finding online resources was very complex. This complexity was further highlighted when the States contributed their own content links to EdNA after going through a complex process to ensure that their State content metadata was compatible with the EdNA standard, to which the States had all agreed. The process for contributing content links was complex, and took considerable time and effort because ICT and metadata were not widely understood at that time. As one interviewee said, 'ICT was not widely used by the teaching profession. Although it (EdNA) was successful, the take up, the usage by the profession wasn't high'. (Respondent C).

Finally, trialling the service independently of the main initiative was difficult even though the collaborative processes did enable the States to learn about developing

their own online services in time. The inability to trial the service meant that the States did not have an opportunity for modification or reinvention of EdNA at the local level. However, as will be seen in the next chapter, when EdNA did make available a range of software applications that could be used by the States, then the take up of EdNA surged.

This situation can be broadly summarised in Table 5.1 below where the presence of each of the antecedents has been indicated by a tick (√) where strong, a half-tick (√/2) strong at the national level only and a zero (0) if weak. Table 5.1 as a summary of the antecedents shows some of the indicators of success and barriers to implementation.

	Rel.-adv.	Compat-ability	Compl-exity	Trial-ability	Observ-ability	Support	Modify
1-Minsterial	√	√	√	0	0	√	√/2
2-National	√	√	√	0	0	√	√/2
3-Company	n/a	n/a	n/a	0	0	n/a	n/a
4-Absent	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 5.1: Levels of influence of innovation attributes

The likelihood of the EdNA initiative being successful, as judged by the antecedents, may have improved by overcoming the barriers of complexity and engaging a wider audience in the States for user trialling and take up. One interviewee went so far as to suggest that:

When it (EdNA) was being set up, the scope should have been broadened to encompass parents and children, as well as the education community ... so that the knowledge and information was promoted as being available to everybody.
It (EdNA) was a little bit too narrow in its scope. (Respondent D)

In summary, although EdNA did undergo continual modification at the national level, it may have needed also to enable modification and reinvention by the States, as users, while at the same time maintaining the relative advantage of the service, its

compatibility with education jurisdictions and the high level support. The complexity of the project and trialling or modification may have been barriers to the development and take up of EdNA during the period of its establishment. Whether they continued to present barriers in the actual take-up is one of the questions which will be addressed in the next chapter, which focussed on the actual take-up of EdNA during the whole period covered by this study.

Chapter 6 Testing the Theory: Rates of Adoption (1997-2008)

Purpose and outline of the chapter

In the previous chapter, the antecedents for the likelihood of success of EdNA were examined as the first step in testing the proposition, from Chapter 3, that:

The successful diffusion of an ICT innovation in education can be assessed by its antecedents, its rate of population take up and the strength of collaboration associated with its development and use.

This chapter reports the second step of the theory-testing, namely, the analysis of the rate of population take up of EdNA.

The chapter begins with a brief discussion of the context of the use of the Internet in education in Australia. Against this backdrop, the chapter presents an analysis of the take up of EdNA from three perspectives. The first is focussed on monthly reports of page-view accesses to resources available through EdNA and the second on the overall mean number of accesses per year. The third then focuses on the monthly usage statistics of the take up of EdNA through its initial stages of development, when populating the service with content was a priority to the implementation of the different EdNA tools for finding online resources (EdNA), then sharing services (EdNA Shared Information Services), collaborating (EdNA Groups) and forming communities through shared interests (MyEdNA or *me.edu.au*).

Finally this chapter identifies the peak periods of EdNA usage for a more detailed examination in the next chapter on the role of collaboration.

The context of the take up of EdNA

The early establishment period of EdNA from 1995 to 1997 was at a time when the WWW was relatively new, having been invented only in 1989 (Gillies, 2000) although the first significant freely-available public browser, Mosaic, was not invented and released until 1993 (Gillies, 2000). The Australian Bureau of Statistics (ABS) tracked the penetration of Internet use by population by surveying Internet use in Australian households as part of reporting about Australian social trends. In Figure 6.1 below the rapid take up of the Internet in Australian households is graphically presented showing that between 1996 and 2000, ABS (2003) reported, 'In the week prior to the 2001 Census of Population and Housing, 29% had access to the Internet at home'. (ABS, 2003, p. 2).

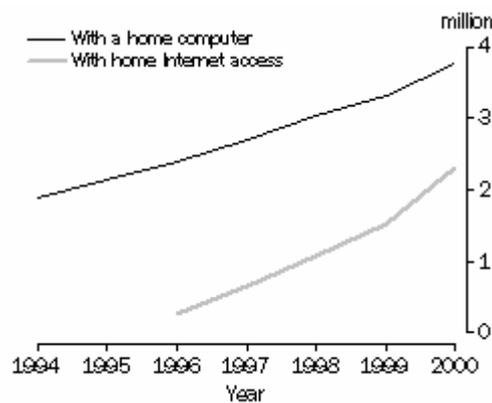


Figure 6.1: Household with Home Computers and Internet Access (ABS, 2003, p. 1)

Although reports prior to 1996 recorded increases in the number of computers in households, from 1996 access to the Internet, see Figure 6.1, was also reported by ABS:

Between 1994 and 2000, the number of households with home computers doubled, and between 1996 and 2000, the number of households with home Internet access increased almost ninefold. In 2000, over half of all households (3.8 million) had a home computer and one-third (2.3 million) had home Internet access. (ABS, 2003)

At the same time, a greater growth of Internet access was being experienced in businesses in Australia (ABS, 2000) although reporting on the use of technology in education had moved from reporting ratios of computers-to-students, to reporting general policy initiatives (MCEETYA, 2000) about technology use in education. However, the number of users of the Internet in Australia remained small in global terms. The Graphics, Visualization and Usability (GVU) Center at the Georgia Institute of Technology, Atlanta, undertook annual surveys of Internet users commencing in 1994. Gvu reported in 1995 that users of the Internet in Australia represented just over 2% of the global total (Georgia Institute of Technology, 1996) whereas the USA accounted for over 73%. This underlined the need for Australia to be connected globally to enable access to information, especially Australian content, which was a major benefit of EdNA for education . As one interviewee said,

We had the superhighway which was, you know the threat of Australia being flooded with content from America in the education sector, so there was an impetus there. The impetus was to move into the area of providing mechanisms to develop ... interactive content for the use in the education communities.

(Respondent C).

The take up of Internet services in education in 1995 was minimal and the Internet was relatively new to education.

Populating content on EdNA (1995-2000)

As described in the previous chapter in the section on relative advantage, the Interim EdNA service which became known as the EdNA Directory Service, commenced development in early 1996 under the direction of DEET (Education Networking Taskforce, 1996). The concept of EdNA as a 'catalogue of resources' (Respondent C) and sharing platform was very new. As one interviewee said:

We were starting to look outwards and touching base with the rest of the world and what was happening in the UK and US. They were not doing anything like

this. They had all the technology that we've got, they've already got more advanced connectivity than we've got but they were not doing anything like this.

(Respondent F)

Establishing the functionality of the service with stakeholders and developing the web service occupied most of 1996, so published figures on the take up by users of the service were not a focus (DEET, 1996b; OLTC Board, 1997; Education.au Limited, 1999b). When the service became accessible, later that year, the prime focus moved to populating the online service by providing links on EdNA to quality content.

The increasing number of evaluated content links enabled users to access quality web based resources and so linking content, with appropriate metadata, became a major focus of EdNA as the service was beginning. As one interviewee pointed out:

There was a push for ICT and when you push for the use of ICT, you have to have resources to use. EdNA was the main service around at the early stages from 1996 to late 1999. Providing resources organised around national curriculum, provided value to them (States). (Respondent C)

There was also an impetus to provide accessible Australian content for education on the Internet. Service agreements for uploading resource links from the States were developed so that EdNA would be a national central point of access to education resources used in each State (OLTC Board, 1997). As suggested by one interviewee:

The States did not have anything as good in place. The smaller states depended on this service because they did not have the resources or the expertise to establish expensive portals with the same services. (Respondent C)

In this way each State shared its resources nationally satisfying a goal of the EdNA project to minimise duplication and maximise impact. The agreement with the States was called a *Service Agreement for the Contribution and Management of Content* (OLTC Board, 1997) and one was signed by each State resulting in significant content being uploaded to EdNA. In this regard Figure 6.2 below shows the

increasing number of content links uploaded monthly from April to December, 1997, leading up to the launch of EdNA in November 1997.

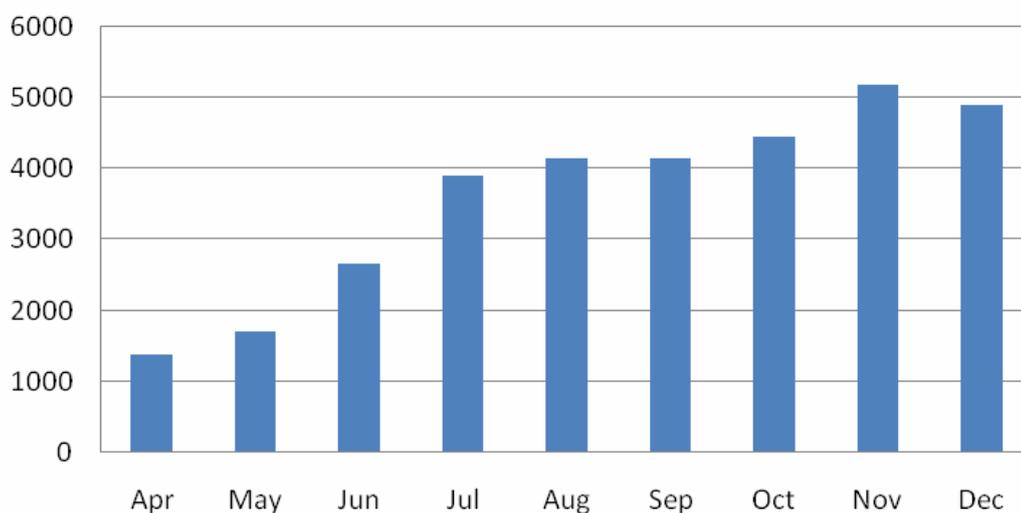


Figure 6.2: Monthly evaluated resources 1997

Sources: EdNA Statistics reports 1997-1998

The effort to increase the number of quality content links on EdNA continued throughout the project. The number of content links uploaded from the States was complemented further by Education.au staff who uploaded evaluated content links at a rate of approximately 100-300 per month, beginning in 1997. Figure 6.3 shows the regular rate of increase of the number of evaluated content links added to EdNA for the period 1997 to 2005.

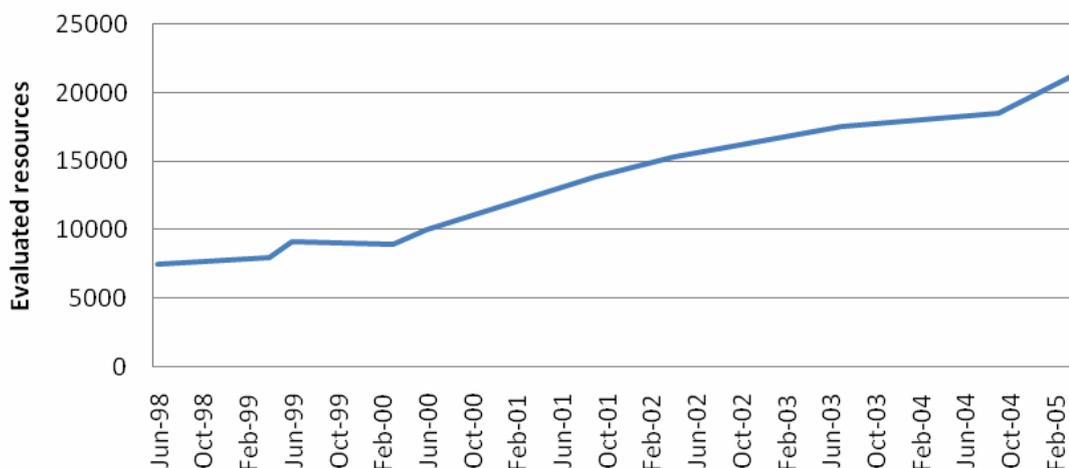


Figure 6.3: Evaluated resources 1998-2005

Sources: EdNA Statistics reports 1997-1998, Education.au Annual reports, MCEETYA reports

Figures 6.2 and 6.3 indicate that an approximation to the S-shape curve of diffusion of innovation was replicated in line with Rogers (2003) theory. However, this was not taken up by the user population because usage statistics were not kept but rather a measure of the linked content contributions to EdNA from the Commonwealth, the States and Education.au staff.

In February 1999, a project was commenced to determine what data was needed to monitor the progress of the use of EdNA by end users and the most appropriate ways for such statistics to be collected. The project, *EdNA Monitoring and User Evaluation* (Education.au Limited, 1999b) resulted in consistent EdNA usage data being collected from September 2000 onwards. Prior to that internal Education.au statistics on accesses to the EdNA servers were collected and reported on a cumulative basis. That is, the number of EdNA web server access commands recorded as 'hits' each month were added to the record from the previous month but were used for internal purposes only. However, as discussed in Chapter 4, the use of 'hits' to gauge usage of online services was unreliable. Hence the cumulative record of 'hits' did not give an accurate assessment of accesses to EdNA and so they have not been reported here.

Take up of EdNA services-three perspectives (2000-2009)

Three perspectives follow: monthly access of resources, overall mean number of access per year and monthly usage for the four main EdNA services.

Monthly accesses resources

During any given year, education tends to have busy periods and not-so-busy periods such as holidays, semester breaks and end of academic year breaks. Hence, as might be expected, the take up of EdNA, as mapped by the monthly data collection of page-view access statistics to the EdNA web pages and resources, varied for each month over a twelve month period. The question arises here as to whether the busy months of the year for education page-view accesses were consistent from year to year?

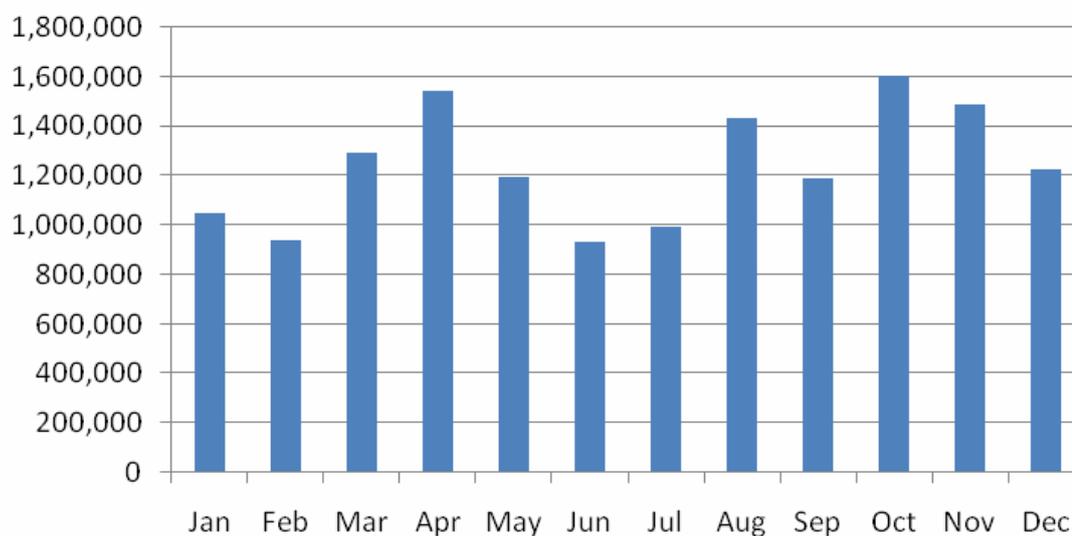


Figure 6.4: Page-views by month for 2002

Source: EdNA Performance Statistics Monthly Summary

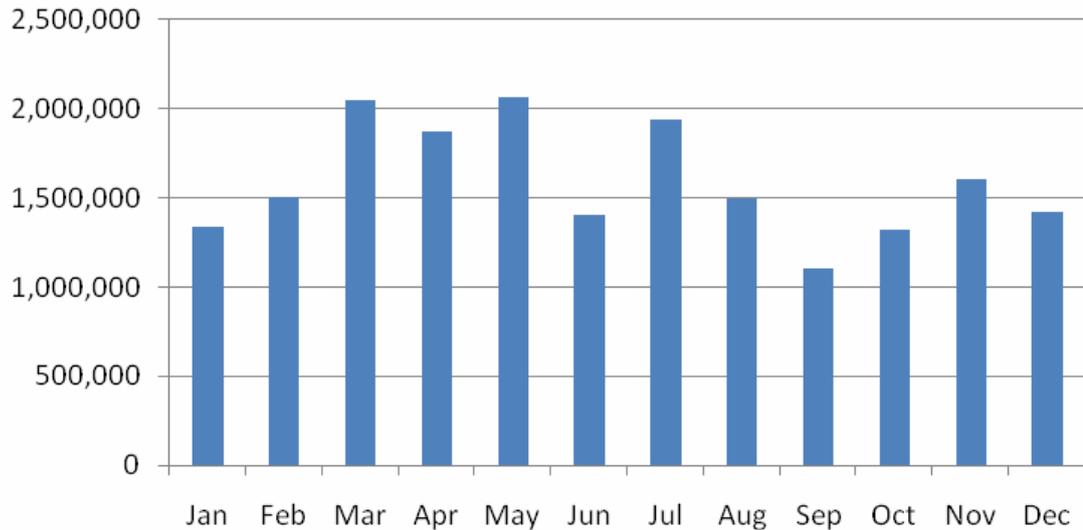


Figure 6.5: Page-views by month for 2003

Source: EdNA Performance Statistics Monthly Summary

Figures 6.4 and 6.5 show the monthly page-view statistics for 2002 and 2003 respectively. It can be seen that, in 2002, the high access months for EdNA were April, August, October and November, and in 2003 they were March, May and July. The high access periods and low access periods might be explained by the activities of the education calendar year but this explanation is not entirely satisfactory because schools, training institutes and universities operate quite differently.

Repeating this process for the years 2004-2008, Table 6.1 shows the three highest page-view access months for each year.

	Month 1	Month 2	Month 3
2001	October	November	December
2002	April	October	November
2003	March	May	July
2004	May	June	September
2005	March	May	June
2006	May	November	December
2007	March	October	November
2008	March	June	August

Table 6.1: Highest page-view access months from 2001 to 2008

Over a period of nine full years, the months that aggregate the highest accesses of page-views would appear to be clustered. March and May are highest four times followed by June (3) to form one cluster while October (3) and November (4) form a second cluster. The first cluster is interrupted by the April education holidays which are almost uniform across all education sectors in Australia because they include the Easter break. This is helpful information because the mean of page-view accesses for each cluster per year may give an indication of the maximum take up of EdNA.

Figure 6.6 indicates an increase in page-view accesses in Cluster 1, the early part of the year, compared to Cluster 2 in the later part of the year. After 2005, there followed a sharp decline. One interviewee commented on this:

At this time, many of the jurisdictions had the means to developed their own collaborative services as well [and] teachers were referred back to their own jurisdictions. There were more choices of services with similar functions to EdNA.

(Respondent A)

If this is an accurate assessment then State preferences for their own services and a wider choice of online services were two factors to take into account when considering the usage of EdNA. In fact, as has been mentioned, EdNA encouraged the States to use online software applications provided by EdNA, so that the States could embed those applications into their own portal services.

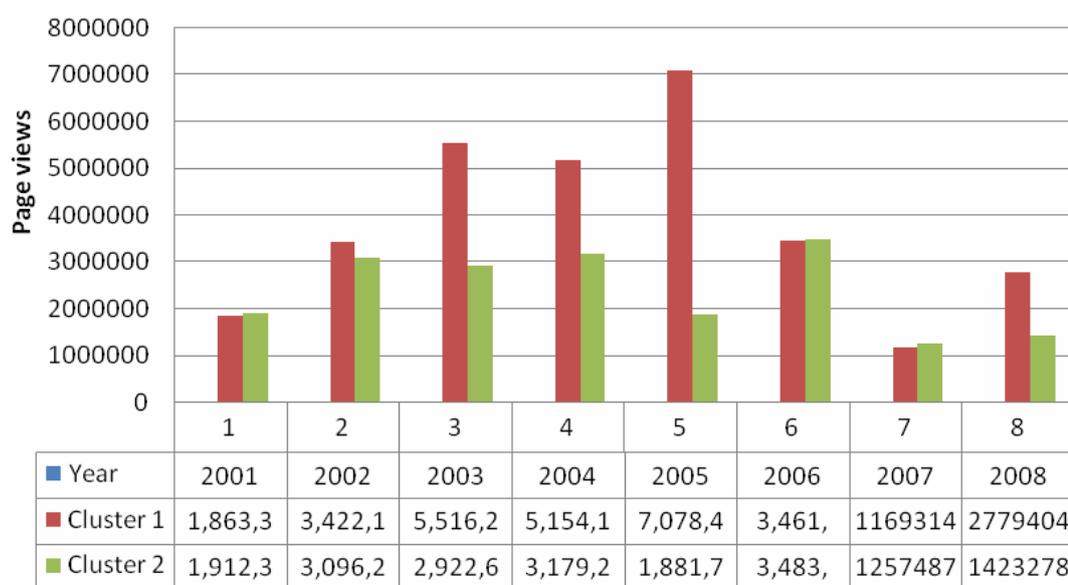


Figure 6.6: Maximum page-view access clusters from 2001 to 2008

Source: EdNA Performance Statistics Monthly Summary

Overall mean number of accesses per year

The second perspective for examining take-up involved calculation of the mean number of monthly page-view accesses for each year. This gave an overall picture, taking into account the page-view access highs and the lows, of the take up of EdNA.

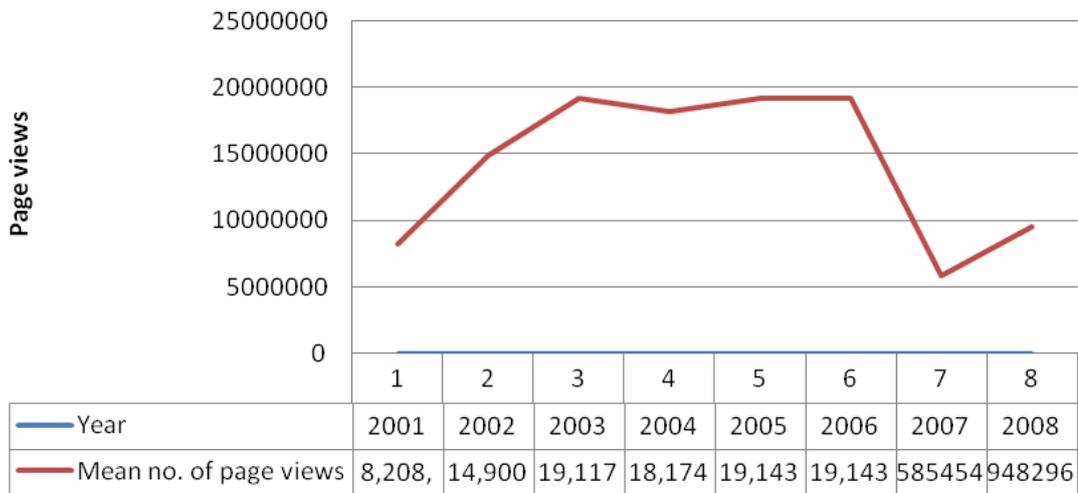


Figure 6.7: Mean page-views per year

Source: EdNA Performance Statistics Monthly Summary

As can be seen in Figure 6.7, EdNA experienced a steady increase in page-view accesses of the resource directory services, until 2003. The accesses then remained almost constant until 2005, after which they declined for the search and web page functions.

So far the analysis of page-view accesses to the EdNA service shows that they were not uniform each month but occurred in two clusters of activity in education for each year. The first cluster of activity occurred between March and June each year and the second in October and November. Secondly, on closer inspection of the clusters of high access there appeared to be a slow growth until 2005, especially in the first half of each year after which a decline occurred. This pattern of take up was confirmed by examining the mean number of page-views per year as can be seen in Figure 6.7 above.

The reason for examining the number of monthly page-views of EdNA so closely was to establish that the take up of EdNA was consistent with the S-shaped curve of diffusion of innovation established by Rogers (2003). This can be demonstrated, by examining page-view accesses to the EdNA servers, to gain a detailed pattern for the

period of growth from September 2000 to July 2005. The pattern of take up of EdNA does broadly follow an S-shaped curve as demonstrated in the Figure 6.8 below although beyond that period other statistics concerning all the main EdNA services need to be taken into account when considering the overall take up of EdNA.

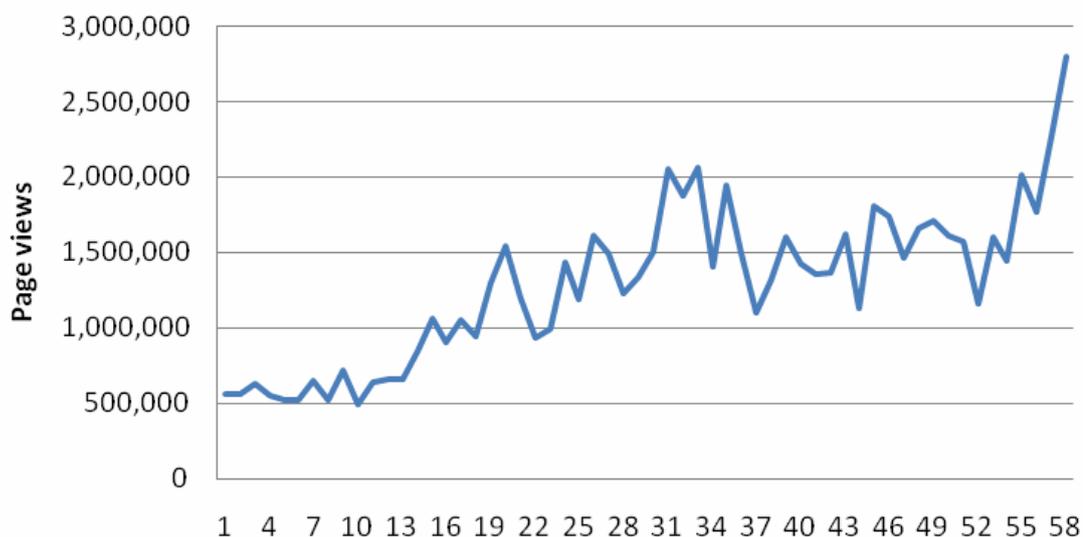


Figure 6.8: EdNA page-views by months from September 2000 to July 2005

Source: EdNA server statistics from AWStats

Monthly usage for the four main EdNA services (1997-2009)

EdNA in 2009 had four main services: the basic EdNA resources search and browse services which have been examined above, EdNA Shared Information Services (formerly List Services) which were new in 2005, then EdNA Groups and finally the 'me.edu.au' EdNA service linking people of similar interests through their professional profiles. Statistics were collected for each of these services from the time that they were initiated although until 2005 statistics for search and list services were reported together as combined accesses to the EdNA servers. An overall review of the page-view accesses to the EdNA Shared Information Services follows.

(i) Shared information services

In August 2005, collection of the statistics for EdNA and the Lists were separated because the news services had become a part of a number of syndicated services and applications that EdNA provided to other portals, including State portals. The separated statistics collections gave a clearer picture of the take up of these EdNA syndicated services such as news, RSS feeds, events and EdNA applications. These EdNA syndicated services became known as EdNA Shared Information Services. In Figure 6.9 below the take up of EdNA's Shared Services showed an increase for the period August 2005 until December 2008.

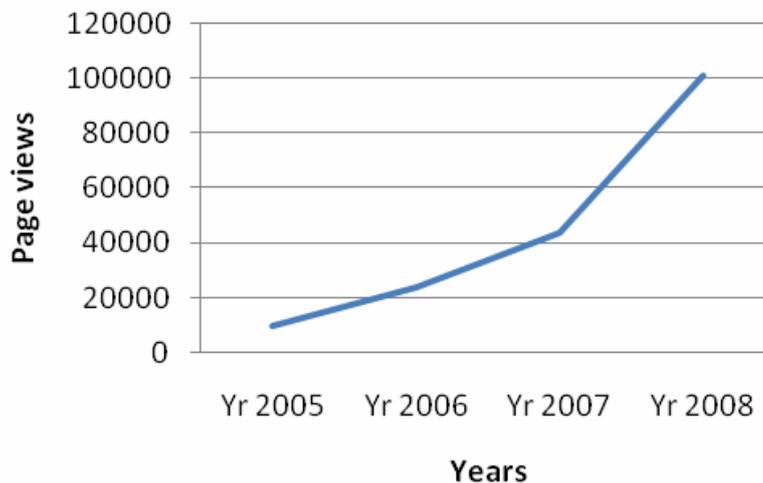


Figure 6.9: Mean page-views for Shared Services by year

Source: EdNA server statistics from AWStats

That was a period, said one respondent:

Where the EdNA initiative needed to respond to the changing both political and Internet environment, [because of] the increasingly sophisticated services starting to be developed by ... the States. EdNA took a really a very innovative approach about how to respond to those changes. It moved from a retail shop model to a wholesale model. (Respondent B)

In this way EdNA was re-engineered to cater for users and also to provide 'shared infrastructure' to support State portals. Another interviewee stated that:

The number of individuals and portal owners that would take EdNA content and modify that or take selected items and syndicate for their own needs, did grow very, very strongly. (Respondent A)

The same person also said that the number accesses of users 'downstream', meaning EdNA accesses from the State portals, was impossible to measure which suggested that the take up of the Shared Information Services was stronger than the EdNA statistics collection actually indicated.

(ii) EdNA Groups

The emergence of EdNA Groups in 2004, initially as an experimental collaborative service, combining previous listservs and forums, hosted by EdNA, also had an impact on the statistics collection for the use of the EdNA services. The take up of Web 2.0 interactive services globally since 2001 was an encouragement for the education and training sector to engage in collaborative online services and EdNA Groups was the response. Groups, built on Moodle software, was an extension of the collaboration that had been occurring already with listservs and forums. The initial take up of the service from December 2004 was a period of high activity as can be seen in Figure 6.10 below. Although the number of groups saw a slow increase from December 2004 until March 2006, the number of members increased sharply.

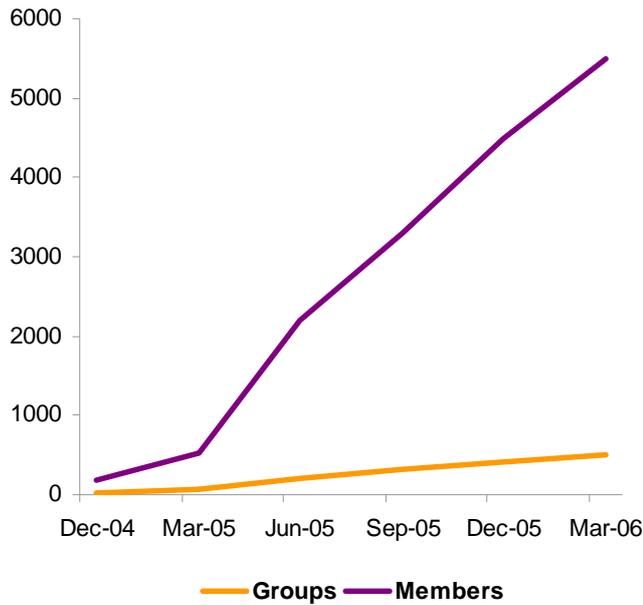


Figure 6.10: EdNA Groups (Tranthim-Fryer, M., 2006, p. 21)

Although the take up was strong in the schools sector as expected, the take up was also strong in the VET sector due to changed funding circumstances. As one person stated:

This (take up) was aided by the fact that the VET sector used to have other collaborative tools outside of EdNA. They were discontinued around 2004. The VET sector at that point was reasonably familiar with Moodle, so it was a fairly easy transition. (Respondent A)

Another respondent added, 'They (the VET sector) were running train-the-trainer programs to train the practitioners' (Respondent C) using EdNA.

The trend for the rapid take up of EdNA Groups continued into 2007 as the plot in Figure 6.18 below shows. Again in this longer term plot of the take up of EdNA Groups, the number of groups increased at a slow rate whereas the number of members increased sharply. During the period March 2005 to December 2007, the functionality of EdNA Groups continued to improve with an increased capacity for collaboration as new functions were added. EdNA Groups filled a niche in education as suggested by one respondent who said:

People wanted to be online. They wanted to be online for various reasons ... basically for communication, a means to share resources, discuss resources and also learn from one another. (Respondent C)



Figure 6.11: Growth in EdNA Groups (Education.au Limited, 2008b, p. 11)

The two graphs in Figure 6.10 and Figure 6.11, of the take up of EdNA Groups initially and then over a longer term, demonstrated the S-shaped curve of the adoption of innovation. However, the take up of EdNA Groups may have distorted the reporting of the take up of EdNA because the users may have limited the growth of other EdNA services. Users may have sought to limit their online time and so changed services to the ones they needed the most, including EdNA Groups, or alternatively, users may have had a preference for such interactive engagement offered by EdNA Groups and reduced their accesses to other EdNA services. As one interviewee observed, '[EdNA] Groups has rich functionality but does need a strong investment in time from the owner or the member to gain full value'. (Respondent A). The take up of EdNA Groups may also have affected the statistical data collection for EdNA accesses for a number of similar reasons. This has been discussed further below where the overall number of page-views of EdNA have been analysed.

(iii) Me.edu.au

The personalised profile service called *me.edu.au* was initiated in February 2008. This new service, somewhat similar to global professional linking services such as *LinkedIn*, enabled educators and trainers to be linked by a number of declared aspects of their personal profile, such as professional interests, study preferences or roles in education, as a basis to form professional communities. The focus of *me.edu.au* was the capacity for members to link to one another by interest and as one interviewee pointed out, 'the individual user [was] able to find resources and .[then].. likely to share the findings which relate and are relevant for him/her' (Respondent C). In Figure 6.12 below, the take up of *me.edu.au*, plotted by the number of registered user profiles, as distinct from page-views, can also be seen to be quite rapid.

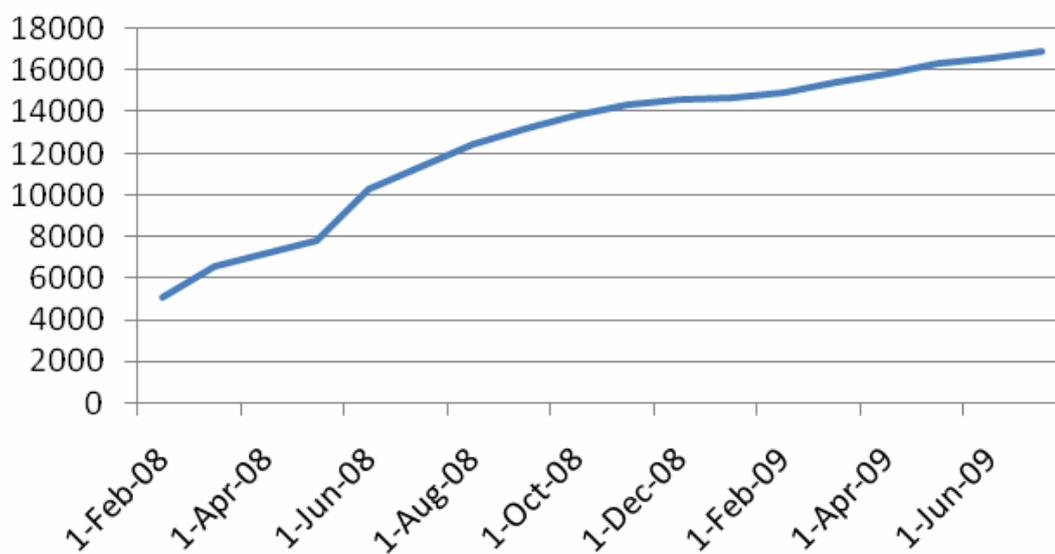


Figure 6.12: Number of user profiles registered for me.edu.au from February 2008 to July 2009

Source: EdNA Groups server statistics from AWStats

The EdNA Groups and *me.edu.au* services although somewhat similar made different time demands on users. As one respondent observed:

something like *me.edu.au* is always seen to be a more light-weight layer (than Groups), easier to jump in the pool, [and] not take big investments initially for educators to become involved. (Respondent A)

As new and improved EdNA services were launched, earlier services may have experienced a decline in usage.

EdNA combined services take up 2006 – 2008

Each of the main EdNA services at different periods experienced keen user take up as measured by page-views and registered profiles (Education.au Limited, 2007b, 2007c, 2008a, 2008d, 2008f, 2008g). These services included EdNA resources (search and web pages) including listservs initially, Shared Information Services (listservs, news, RSS feeds, events, EdNA applications), EdNA Groups and *me.edu.au*. In addition, there was a small number of sundry EdNA services such as an experimental sandpit and sibling sites, and Web Services that used EdNA's resources but had defined views limited by their own fields of interest such as science, English and other areas. However, the use of these services was quite small. However, the take up of EdNA when the main services were combined as a cumulative record of the overall data showed an increase in usage.

In Figure 6.13 below 'visits' per month between January 2006 and March 2008 have been shown for all of EdNA's services. The statistics reported in Figure 6.13 measure server requests rather than downstream user visits. Usage data excludes page spidering (e.g. Google) and internal Education.au administrative use. The additive nature of the EdNA services has been demonstrated by using a stable measure, such as 'visits' data, available since 2006, and then combining the results for each EdNA service. Although the actual take up of EdNA continued to improve, measurement became more complex as the number and types of EdNA services increased. Due to this complexity the statistics for *me.edu.au* were not included as they were not comparable.

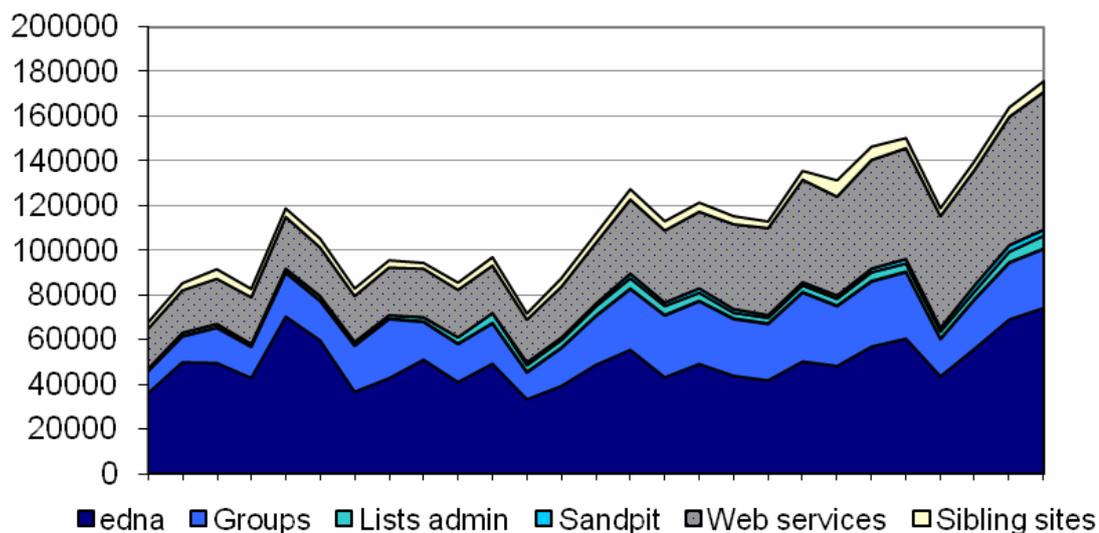


Figure 6.13: Aggregated EdNA service visits (sessions) per month: January 2006-March 2008 (Education.au Limited. 2008c, p. 4)

Although the growth of the EdNA services has continued, what can be envisaged is the continual slope of the gradient consistent with the S-shaped curve of diffusion of innovation put forward by Rogers (2003). However, as Mort (1953) commented, 'The average American school lags 25 years behind best practice'. If that is the case today in Australia then the take up of online services may yet take many years and EdNA may be just one part, albeit an important part, to enable and stimulate the take up of education online services in Australia.

Overall EdNA take up

The overall take up of EdNA can be seen by plotting the page-views for the major EdNA services from the commencement of reported statistics in September 2000 to the present in July 2009. Page-views have been used as a regular and consistent collected statistic for each of the major EdNA services such as EdNA search and web, EdNA Shared Information Services and EdNA Groups. Reported statistics for *me.edu.au* are based on the number of profiles of users engaged with the service and so have been shown separately above in Figure 6.12.

There are two views of the usage statistics that show the overall growth of EdNA and they highlight different aspects. The first view is a scatter view with the mean path of the number of accesses using page-views as the unit of measurement to demonstrate a pattern of take up. Overall, there has been a steady increase in the take up of EdNA with both peaks and troughs. Although removing the education holiday periods would appear to eliminate low usage, this is not always the case because each of the education and training sectors and States have different holiday breaks. Therefore calculating a mean line of the page-view clusters gave a truer picture of overall take up as shown in Figure 6.14 below. The linear mean of page-views shows that there has been a steady but slow take up of EdNA over the 106 months of collected statistics, replicating the S-shaped curve of Rogers' diffusion of innovation.

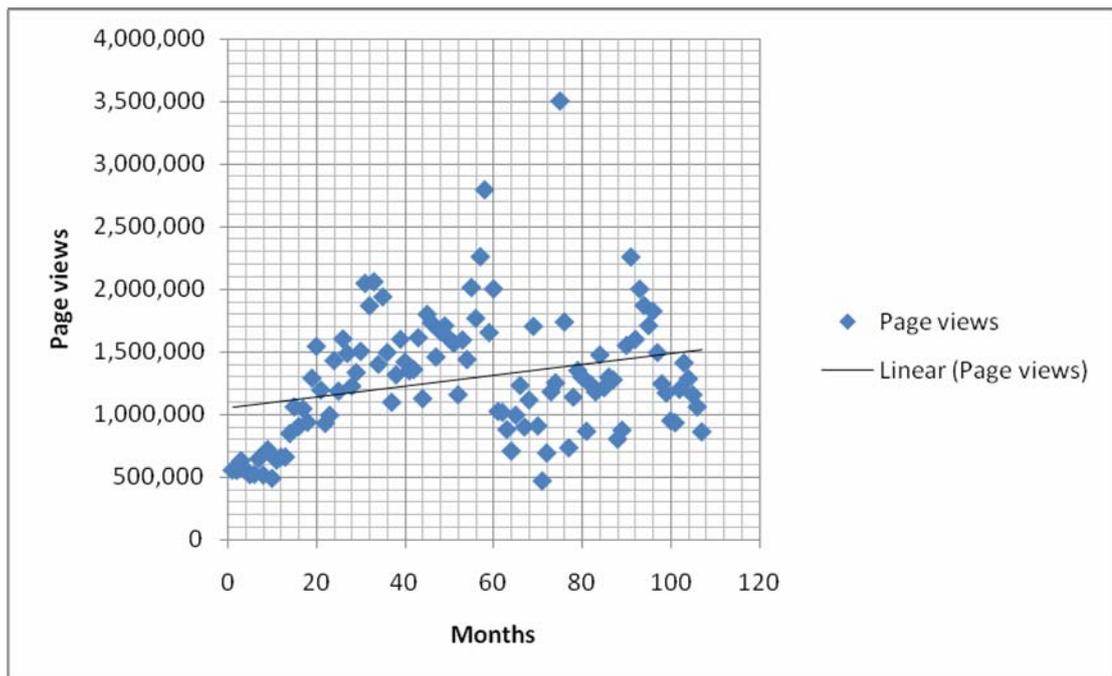


Figure 6.14: Page-views month clusters with linear mean from September 2000 to July 2009

Source: EdNA server statistics from AWStats

A second view is the actual take up expressed in page-views and accumulated where more than one service exists. In Figure 6.15 below, the number of page-views for EdNA from September 2000, has been increased by the number of page-views for EdNA Shared Information Services from August 2005 and again by the number of page-views for EdNA Groups from September 2006. The EdNA statistics for the three services, which each start at different times, have been accumulated where possible.

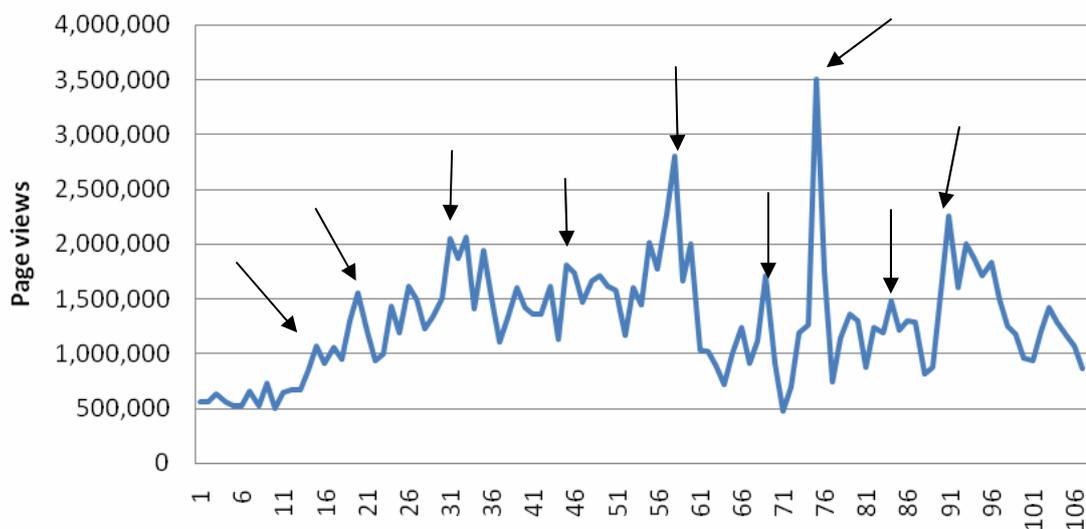


Figure 6.15: Accumulated page-views by months: September 2000 to July 2009

Source: EdNA server statistics from AWStats

The accumulated page-views by months, numbered from 1 to 106, for EdNA resources, EdNA Shared Information Services and EdNA Groups has been shown above in Figure 6.15 where a series of steady rises and falls with some sharp rises in the number of page-views by users at peak periods can be seen. The overall peak months of EdNA's take up have been marked. Each peak has been followed by a decline in usage and then the pattern repeats itself. The peaks can be isolated to the following numbered months in Figure 6.15: April (20) and October 2002 (26), March (31) and April 2003 (33), May 2004 (45), June 2005 (58), May (69) and November 2006 (75), Aug 2007 (84) and February 2008 (91). The next chapter reports the closer examination of these peak usage months in an attempt to explain the peaks,

especially in terms of any association between collaboration and the growth near the peak usage periods.

Summary of EdNA take up

Initially, the collaborative Commonwealth, State education and other partners concentrated on popularising the EdNA site with quality content links from their own and other reputable sources, so the collection of take up statistics did not occur until later, in September 2000. However, the content links uploaded to EdNA followed the S-shaped curve of Rogers (2003) theory of diffusion of innovation. So too did the EdNA resource service initially, as did the EdNA Shared Services, EdNA Groups and the personalised *me.edu.au* service. However, an important observation was that the take up of EdNA, as seen in Figure 6.15, was very gradual and showed that the take up or diffusion of innovation of EdNA in education occurred over a period of a decade. Also of note, is the fact that EdNA was not used consistently throughout the year due to the education calendar breaks and that usage during March to June and also October to November was high whereas in the other months usage was lower on most occasions.

The overall pattern showed steady growth overall and with periods of high growth concentrating in peaks, although the take up of each of the EdNA services did follow an S-shaped curve, when the number of accesses for each of the services was accumulated. The peaks were followed by sharp decreases in usage which were not always education break periods as expected. As indicated above, the examination of these peaks and troughs will be explored in the next chapter.

Chapter 7: Testing the theory: the role of collaboration

Purpose and outline of the chapter

In the previous two chapters, the likelihood of the success of EdNA as an ICT innovation in education and the take up of EdNA's services by its user population were examined. This chapter follows on from the work of the last two chapters and examines the role of collaboration that was evident in the take up of EdNA in order to test the theory proposed in Chapter 3.

The first section of this chapter begins with a short discussion of the links between collaboration and diffusion. It then presents an analysis of the role of collaboration during each of the five phases of EdNA's development and implementation, working chronologically from the initiation phase (1995-1997) through to the personalised service phase (2007-2009). This is then followed by an analysis of collaboration during some of the EdNA projects that did not succeed and finally, during peak periods of the take up of EdNA's services, as identified in Chapter 6.

Links between collaboration and diffusion

Both ideally and practically, the culture of education for teachers is one of professional learning through collaboration and the formation of learning communities. As cited in Timperley (2007), Newmann (1994) said:

It [teaching] usually requires information, expertise and support far beyond the resources available to the individual teacher working alone in an isolated classroom. Teachers who collaborate with their colleagues are more likely to be effective with students, because they will benefit from expanded resources.

(Newmann, 1994, as cited in Timperley et al, 2007. p. 202)

Timperley (2007) identified the link between professional learning and collaboration in a number of studies, noting that:

Nearly every core study that described school-based professional communities reported greater collaboration among teachers and more collective responsibility. (Timperley et al, 2007, p, 205)

The research by Timperley et al (2007) supports the view that learning communities of teachers working together collaborate to share resources and good practice. Arguably, the availability of online services in education has enabled collaboration among teachers to occur beyond the confines of the school. Teachers are able to undertake professional learning using online collaboration services such as those available on EdNA. The notion of sharing resources by collaborating with colleagues underscores the purpose of EdNA and, as argued by Timperley (2007, p. 205), collaboration and collective responsibility represent a change from individualism and autonomy in professional learning.

The diffusion of innovation is marked by the possibility of change. The take up of EdNA was an innovation in education which was new and nation-wide. It required teachers as users to consider some changed ways of finding information and communicating with colleagues and other professionals. For example, searching for information online using the WWW was a new way of accessing information in the period that EdNA was developed. The take up of EdNA was characterised by the potential for change in education by creating a network for sharing resources and to 'deal with the emerging issue of net safety' (Respondent F) suggested one interviewee.

In this chapter the theory of diffusion of innovation in education will be tested for collaboration and its role associated with the take up of EdNA. The theory, as previously stated in Chapter 3, was:

The successful diffusion of an ICT innovation in education can be assessed by its antecedents, its rate of population take up and the strength of collaboration associated with its development and use.

The definition of collaboration and its characteristics have been repeated here for the sake of consistency. Collaboration was defined in Chapter 3 as:

the process of co-creating knowledge while sharing physical or virtual space.

The eleven characteristics of collaboration, which were detailed in Chapter 3, together with the sources of data related to these characteristics are restated in Table 7.1.

Characteristics of collaboration	Information sources
<i>shared leadership</i>	Documentation from meetings, information releases and communication among those involved
<i>common goals</i>	
<i>shared process and framework</i>	
<i>shared decision making</i>	Perspectives from key players derived from interviews
<i>mutual responsibility</i>	
<i>change resilience</i>	
<i>network intelligence</i>	Personal reflections of the researcher, explicitly stated.
<i>flexibility and responsiveness</i>	
<i>open communication</i>	
<i>diversity in thinking</i>	
<i>appropriate level of technical competence</i>	

Table 7.1: Table of collaboration characteristics and sources

In the Table 7.1 above, one of the sources of information, previously identified, was the researcher. Where the researcher has included a personal reflection in the text, the statement has been clearly attributed and supported by other sources of information.

Collaboration and the phases of EdNA's development

The major phases of the development of EdNA, first described in Chapter 2, have been used as the basis for an examination of EdNA's antecedents and take up. The phases, listed below, also have been used to examine collaboration, and are:

- The initiation phase 1995 to 1997
- A directory service of evaluated resources 1996 - 2009
- Shared Information Services 1996 - 2004, 2005 -2009
- Group collaborative services 2004 - 2009, and
- Personalised services 2007 – 2009.

Once the service began, the phases of EdNA's development were not discrete in time but overlapped considerably. For example, although the directory service was the initial service, it continued to be enhanced and has been used as part of EdNA throughout its history. In the same way, Shared Services included lists and news services which were initiated in 1996 and continued to be enhanced and used as part of EdNA's services. Services once initiated and launched as part of EdNA continued to be used even though they may have been reshaped, modified or enhanced, or declined along the way. Rogers (2003) innovation-decision processes can help to understand the role of collaboration, at each phase of EdNA's development, as the characteristics of collaboration are examined.

As discussed in Chapter 3, Rogers (2003) developed five aspects of the innovation-decision process as part of the diffusion of innovation process: *knowledge*, *persuasion*, *decision*, *implementation* and *confirmation*. These aspects of decision making will also be discussed when considering collaboration because they take into account the social and communication systems involved.

The initiation phase

As documented in Chapter 2, EdNA was announced in April 1995 by the Commonwealth Government, agreed by the States in May 1995 and then initiated in June, 1995, at a meeting of a small Expert Working Group led by the Commonwealth (Gibbons, 1995b). The idea of EdNA was new and consultations with each State were planned in order to develop a Business Requirements Analysis paper (DEET, 1995d) for the States and Commonwealth to consider before proceeding. However, in order to initiate discussions for the consultations, an issues paper (DEET, 1995b) was prepared and distributed by the Commonwealth.

During the four month consultation period, a panel met with each State to discuss a number of questions based on the issues paper about the establishment of EdNA (DEET, 1995b; 1995d). This stage of the initiation can be regarded as part of Rogers (2003) innovation-decision process of five stages: knowledge, persuasion, decision, implementation and confirmation. Through the consultations, the States gained knowledge about the EdNA initiative and were persuaded to pursue EdNA in collaboration with the Commonwealth. Their decision to engage in the project came later when the paper (DEET, 1995d) was accepted in October 1995 and implementation occurred when the States agreed to arrange for Ministerial acceptance of the business plan in November, 1995 (MCEETYA, 1995c). Confirmation of the innovation-decision occurred when the all the State Ministers had signed. Implicitly, the innovation decision-process underpinning this initiative was one of collaboration and cooperation. (MCEETYA, 1995b).

The strength of collaboration during this initiation phase of EdNA can be judged by examining the eleven attributes of collaboration from Chapter 3: shared leadership, goals, processes, decision making, change, intelligence, flexibility, communication and diversity in thinking and appropriate level of technical competence.

The initiative was prepared by the Commonwealth which developed an issues paper and lead the consultation of questions from the issues paper with the States. Each of the consultations with the States occurred with high level Commonwealth officers

and some members of the Expert Working Group meeting with high level State education officers. Although the Commonwealth lead the consultations, as opposed to distributed leadership, the goals, processes and decision making were clear to the participants. The appropriate level of technical competence and intelligence had been provided by the issues paper which did encourage diversity in thinking for the responses to accommodate the needs of each State. The communication was clear and understood by participants through further consultation about the responses which were brought together in a draft EdNA *Business Requirements Analysis* paper (DEET, 1995d). This draft underwent further consultation and comment prior to the completion of the final EdNA *Business Requirements Analysis* paper distributed to the States for Ministerial endorsement. The process indicated a high level of flexibility within the framework established by the Commonwealth in their issues paper.

Thus in the initiation of EdNA as an ICT innovation in education all of the attributes of collaboration were present to a degree. Collaboration was strong 'in the early phases' suggested one respondent who went on to say, 'People could see that by working together there were benefits to those people who committed strongly to the initiative'. (Respondent B). Overall there was considerable evidence that collaboration as a process of co-creating knowledge while sharing physical or virtual space was present during the initiation phase.

A directory service of evaluated resources 1996 – 2009

The notion of EdNA as a directory service was raised in the *Education Network Australia: Draft Business Requirements Analysis* paper (DEET, 1995d, p. 24). However, considerable new work was needed before EdNA could store information from other sources that could be accessed online simply. As described in Chapter 2, content guidelines had to be developed and categories for storing information needed to be agreed as did keywords and search terms, known as metadata, for finding information.

Development of these three tasks: content policy, categories and metadata, were carried out in different ways. The EdNA Business Requirements Reference Group considered a paper prepared by OLTC, *Classification system for interim EdNA service* (DEET, 1995f) at its meeting on December 15, 1995, about categories and metadata. Then on January 24, 1996, the EdNA Networking Business Requirements Reference Group established a sub-group to be known as the EdNA Directory System Working Group (DEET, 1996c) to pursue those tasks. The OLTC in partnership with Melbourne University developed a draft *Interim EdNA: Proposed Guidelines for Content Provision* (DEET, 1996d). Finally, the role and functions of the EdNA Directory Service, including policy guidelines, categories and metadata, were confirmed in a further paper by the Commonwealth, *EdNA Directory Service* (DEET, 1996e).

An examination of Rogers (2003) innovation-decision processes applied to EdNA showed that although the decisions for undertaking the tasks were agreed by the EdNA Networking Business Requirements Reference Group, the leadership for developing content policies, EdNA categories and metadata were distributed and led by people with the required expertise. The knowledge was jointly developed through the EdNA Networking Business Requirements Reference Group and the contributions of States enabled members to be persuaded and make a decision to pursue an agreed course of action. As one respondent stated:

I would say that collaboration was strong and it was really characterised by the governance ... through the ERC, Advisory Groups and leadership was through those groups. Collaboration was strong and there was goodwill to achieve something. (Respondent C)

Implementation happened through participation in the sub-groups and confirmation took place when the work of the sub-groups was confirmed by the EdNA Networking Business Requirements Reference Group where all of the States were aggregated (DEET, 1995g).

The characteristics of collaboration would appear to have been evident during the early stages of the development of the EdNA directory service. Shared and

distributed leadership was evident through the Advisory Groups and through the extensive consultation processes with the States. As has been noted earlier, meetings of the ERC and Advisory Groups had common goals, shared processes, an agreed framework, shared decision making and mutual responsibility. One respondent commented:

Each of the sectors was adding something [although] collaboration was strong and served a purpose in the school sector [it] was not strong in the VET and higher education sectors... because they received a lot of funding to establish infrastructure and also to provide leadership in ICT. (Respondent C)

Flexibility was enabled through participation in the sub groups and participants operated responsively by providing feedback on draft papers as witnessed by the researcher. Communication occurred between participants by means of email and telephone which were supplemented by physical or video conference meetings 'Having email enabled us to share' (Respondent F) suggested an interviewee. Members did engage with appropriate levels of technical competence through their contributions, where it was required, and shared the decision making in the sub-groups. Decisions of the sub-groups were confirmed by the EdNA Business Requirements Reference Group described in Chapter 2. Thus collaboration in the early stages of the development of EdNA directory service occurred across the whole initiative although it was stronger in the schools sector than the VET or higher education sectors.

As time went on, AICTEC (formerly the EdNA Reference Committee) continued to monitor the progress of EdNA and annually from 1998 to 2001 reviewed plans for the further development of EdNA and approved them by recommending to the Commonwealth the approval of contracts (researcher recollection) for EdNA. The plans prepared by Education.au were the result of a national consultation with States about schools and training needs, and nationally also for higher education (Education.au, 2001a). Then in 2001, AICTEC became the EdNA Reference Committee and was restructured. Subsequently, EdNA became a part of the Education.au report to AICTEC as but one item on the agenda. AICTEC had moved to a broader focus on national issues affecting the take up of elearning in Australia.

In preparing the plans for EdNA's development on an annual basis, Education.au consulted with the Commonwealth and States in the education and training sectors, and developed plans based on their expressed needs for the EdNA service, for the forthcoming financial year. Leadership was vested in Education.au for the operational matters of consultation while decision making remained with AICTEC. The consultations were often not at an appropriate level of technical competence because State officers were often replaced and communication was directed towards cooperation (researcher recollection). Although there was an agreed process for the consultations and commitment to a national framework, there did not appear to be common goals or a mutual sense of responsibility 'The Advisory groups were not always supportive of the central body or the management body', said one interviewee (Respondent C). The consultations did provide evidence of network intelligence, flexibility and diversity in thinking as was evidenced by the constant changes that were made to the draft content and metadata papers. However, this process of national consultation cannot be regarded fully as collaboration but rather it was cooperation because the characteristics of collaboration were only partly evident in the documentation and the interviews. In addition, approval for EdNA's development plans, following consultation with the States, was the province of AICTEC after which the Commonwealth provided the funding on the basis of a contract.

More detailed consideration of the EdNA development plans did occur through a new internal Education.au EdNA Reference Group (not to be confused with AICTEC) responsible for the governance of EdNA. The proposal for this body (Education.au, 2000a; 2000b) provided for a sectoral (schools, training and higher education) representative body to advise on EdNA's plans and to monitor the regular EdNA contract reports which included progress on EdNA's annual development. The plans for EdNA's annual development, prepared by Education.au and based on an annual workshop, were the subject of consultations with the States. When adjustments had been made to the EdNA plans to accommodate the needs of the States, then the plans were scrutinised by the ERC (Education.au, 2000a; Education.au, 2004b) and forwarded to the Board of Education.au for acceptance before being sent to the Commonwealth for funding approval (Education.au, 2001a).

Shared services 1996 – 2004, 2005 - 2009

Shared Services had their origins in the *Draft Business Requirements Analysis* paper (DEET, 1995d) through the inclusion on EdNA of email distribution lists, known as listservs, discussion and chat groups. Each of the education sectors (schools, training and higher education) separately distributed information to those involved via the listservs (Kemeny, 1996) which increased in approved members as the activities and discussions became more diverse. Eventually the use of listservs led to a subscription based email newsletter, called an *Information Alert*, which was initiated to keep stakeholders informed (Education.au Limited, 1997a) about the progress of EdNA together with relevant education and training news.

News services such as the *Information Alerts* evolved into dedicated electronic newsletters for schools, training and higher education with the addition of a number of general newsletters. Although items were submitted by stakeholders from time to time, the email newsletters were managed by Education.au from information supplied by reliable sources, for example universities, the ABS, and State education departments as well as the Commonwealth with some material from international agencies such as the Becta. Selection of items for electronic newsletters was undertaken by Education.au which had an operational role guided by the policies that had been developed for the EdNA Directory Service.

However, in 2004, Education.au prepared a paper entitled *Shared Online Content and Services* (Education.au, 2004b) to introduce the concept of integrated shared, common and web services for discussion by ERC and the Education.au Board. Following acceptance by both groups, the paper was then discussed at a number of State workshops organised by Education.au. The paper was then adjusted so that it included discussions with the States and then it was agreed by the Commonwealth as part of the contract for EdNA services. Shared Information Services (SIS) added syndicated news services or RSS⁷ feeds which could be used to notify news, web site changes and new blog posts to the existing listservs. SIS were finally launched in 2005 (Education.au, 2005b) and reliable statistics of usage were maintained. The

⁷ RSS stands for Really Simple Syndication

take up of shared information services was strong. As pointed out by one respondent, 'The State and Territory education systems were now in a better position to take up those innovative services. We saw a significant growth'. (Respondent B). Another person recalled a 'strong take up in higher education ... in their teaching and learning and education faculties,' (Respondent A) which added a new group of users to engage with EdNA.

A brief review of the characteristics of collaboration is illuminating here. The decision making was largely a matter for funding by the Commonwealth when all parties had agreed and an agreed process and framework was evident. In the quarterly EdNA contract reports to the Commonwealth, from 2002, the following wording was included:

The contract between DEST and education.au limited, titled *Funding Contract regarding core funding*, requires four quarterly reports which are to be considered by the education.au limited Board. (Education.au, 2002b)

The report then went further to include the consultative mechanism that was to be used in the ERC (formerly (EORC) when it stated:

This fourth Quarterly Report includes a review of EdNA Online deliverables by the EdNA Online Reference Committee (EORC), which met on 23 July 2002. EORC comprises a DEST representative, sectoral representatives, an IT expert, company staff and observers (including EdNA Online Project Managers from the higher education, schools and vocational education and training sectors).

The quarterly EdNA progress report has been completed to reflect the comments and suggestions of the EdNA Online Reference Committee in relation to EdNA Online. EORC serves as a high level Steering Group for EdNA Online hosting, maintenance and development activities. The CEO of Education.au Limited chairs the committee. (Education.au, 2002b)

These or similar words have been used as a regular introduction to each of the quarterly consolidated reports to the Commonwealth on the progress of EdNA, since 2002.

Education.au had carriage to take the consultation forward each year. It was responsible for the innovation, gathered its own intelligence which was drafted into an issues paper, was expected to be flexible to accommodate State needs, was detailed in its communication of workshops and accommodated diversity of opinions in the final paper (Education.au Limited, 2003b, 2005a). However, the process was not without risk. One person was quite clear in the statement that:

It (collaboration) wasn't as necessary or as strong in the latter period but the risk there was that we could potentially go in directions that did not suit the State and Territory education systems (stakeholders). The fact that there was a level of confidence in what we were doing also became a bit of a risk to the company, However, there were greater expectations from the users that they could connect.

(Respondent B)

This process can be regarded more as cooperation (Himmelman, 1993) as opposed to collaboration based on the characteristics of collaboration because shared leadership and acceptance of mutual responsibility were no longer evident.

Group collaborative services 2004 - 2009

The introduction of Group services on EdNA in 2004 occurred at a time when the Education.au internal ERC was well established having commenced in 2000. The Board of Education.au was also well established and in addition, AICTEC addressed elearning issues on a broader scale rather than focussing only on EdNA. The context in which Education.au operated EdNA had changed and Education.au now provided the leadership role in the innovation and development of services for EdNA, through consultation with ERC, the endorsement of plans and progress reports by the Board, and the funding approval from the Commonwealth. However, each year to guide the directions for development of EdNA, Education.au convened and managed a national consultative workshop called the EdNA Development Workshop (EDW) to consult on the future development of EdNA. This annual EdNA development workshop, in addition to further consultation with the States on development issues raised at the

workshop, enabled Education.au to maintain an innovative edge by engaging with the network intelligence of stakeholders as well as taking into account the opinions of EdNA users. These user opinions gathered online provided diversity in thinking for the Education.au leaders to consider when planning future EdNA developments.

The introduction of EdNA Groups by Education.au occurred when a decision was made to upgrade a forum service for online collaboration and managing online courses called Janison Learning Management Systems. Education.au formed a group of users to be testers from the States called the Collaborative Workspace Consultative Group (Education.au, 2005b). This group enabled Education.au to trial the new online Moodle collaborative service which also integrated the former forums and listservs, and to fine tune it as a mature robust collaborative service. Online collaboration was given a more functional capacity as a service on EdNA which now used blogs and other so called Web 2.0 applications. The take up by users was very strong as one interviewee observed, 'from 2004 till the first three or four years I think the groups was one of the flagship collaborative tools and growth was very strong' (Respondent A). The same respondent suggested that this EdNA Groups service had strong take up in both the schools and the VET sector.

The characteristics of collaboration are of some interest here because of the extensive online discussion among users about the development of this new EdNA service. An online Collaborative Workspace Consultative Group of users worked with Education.au online with shared common goals and processes within an agreed framework. Shared leadership and shared decision making about the details of the development and the functions of EdNA Groups occurred online with a high degree of flexibility and diversity in thinking. Participants were responsive online and their contributions were at an appropriate level of technical competence because they self selected their involvement. The development of EdNA Groups utilised the knowledge of those involved and their networks demonstrated the multiplier effect of working in networks. 'There was less contact with jurisdictions (education systems) although it was important,' suggested one respondent, but 'much more contact with practitioners during that time' (Respondent A). Another suggested that, 'that there was strong endorsement of the need to establish collaborative workspaces to enable the users now to work across boundaries' (Respondent B).

The level of collaboration of online users in the development of EdNA Groups was strong (Education.au Limited, 2008e). However, although the Education.au Board and the Commonwealth established the processes and framework for approval and acceptance of the development and management of EdNA Groups, the level of collaboration among stakeholders was not strong. A separation between the consultation processes of the stakeholders for the formal decision making and the online collaboration among users engaged in operational matters led by Education.au had become evident. The shift in focus was commented upon by one respondent who said:

I think in recent years probably the shift in collaboration moved, where the connections with the stakeholder jurisdiction levels started to diminish and shifted to more direct contact with the end users. I think that was a very strong strategic shift. (Respondent A)

Personalised services 2007- 2009

The fifth phase of the development of EdNA was a personalised service for professional educators to form communities by linking personal interests. Users did this by linking selected interests nominated in user profiles to one another or through integrating nominated interests with other services such as EdNA Lists and EdNA Groups (Education.au Limited, 2008e). This service, originally called MyEdNA was a customisable space launched in 2002, then rebadged for public release as *me.edu.au* and launched as a beta service in November, 2007. The beta service had '4000 teachers participating in the beta testing of the new service prior to launch' (Black, 2008). The service was launched fully in May of the next year (Education.au, 2008b) and was developed using similar processes to the development of EdNA Groups but with a greater number of online participants providing feedback and suggestions for improvements.

The *me.edu.au* discussions and proposals were also taken to the States for discussion and feedback so that the plans could be improved and refined. (Education.au, 2008e).

Although EdNA Friends, an online discussion group, and stakeholders were informed of the progress of the development of *me.edu.au* using email distribution lists and posts on the EdNA site itself, a large number of online beta testing participants made full use of the network intelligence. Collaboration using online means was very strong judging by the number of active online users providing feedback. As one interviewee commented, 'the provision of the services around it grew iteratively and using a feedback loop of the user base' (Respondent A) online collaboration grew. Apart from the engagement of the online feedback forum, the Education.au ERC was the main group for consultation and approval of MyEdNA's progress with final endorsement by the Education.au Board and approval by the Commonwealth.

The development of *me.edu.au* utilised network intelligence through online participation where the goals were common and the processes and framework were shared as was the decision making (Education.au Limited, 2008e). Collaboration in the development of *me.edu.au* using online services was stronger at this time than before. Change resilience was present through the suggestions of the online forums and the online component was flexible and responsive with open communication evident as was the diversity in thinking (Education.au, 2008e). The levels of contribution were at an appropriate level of technical competence because the participants self selected themselves for the online service feedback forums and those attending the consultations were also from education department sections interested in online services. The leadership of Education.au was acknowledged throughout the consultations and the characteristics of collaboration were evident as part of the online processes of development, feedback, consultations, testing and usage.

Summary of the major EdNA phases

EdNA was developed and managed through five major phases beginning with an initiation period of two years. During those two years, the EdNA project was new and exciting, knowledge of the Internet and its WWW service was rare, and there was a shared national education need and interest among educational leaders to harness the capacity of the WWW to benefit education.

The Commonwealth began intense work consulting with the States, developing issues and position papers for agreement and harnessing the capacity of the States to develop policies, procedures and a framework for developing and managing EdNA. Many issues confronting those involved in the project were without precedent and required considerable discussion and creative solutions to the problems that emerged. There was considerable evidence to suggest strong collaboration in the early stages of establishing EdNA.

However, as consultative and advisory committees were established during the development of the directory service and then the shared services, the nature of the consultation changed. The committees changed their focusses to broader national technology issues in education and training, and the formal discussions about EdNA became one item, often noted, on each committee's agenda. This was a period of consultation and cooperation for the development of EdNA as the national focus of attention shifted. However, after 2000, when the Education.au ERC was formed and the annual EdNA Development Workshops emerged to gather ideas for future EdNA developments national collaboration shifted over time from collaboration among stakeholders to online collaboration among users.

The development of EdNA Groups and *me.edu.au* occurred when the capacities of EdNA could be used for online consultation. Evidence of the presence of some of the characteristics of collaboration was documented for both physical meetings with State jurisdictions and discussions of issues canvassed at the online EdNA Development Workshops, as well as through engaging users in online deliberations. The online interactive feedback from interested users demonstrated a higher level of collaboration than among the States as stakeholders.

Although the Board monitored EdNA's development progress and the ERC engaged in consultations and support for EdNA Groups and *me.edu.au*, the Commonwealth remained the approver for funding. This gave Education.au the framework within which the new services could be developed and online contributions to development could be sought. The online engagement of participants in the development of these

two services, by engaging them in the trials and beta periods, demonstrated strong characteristics of collaboration. As an interviewee said:

From a user perspective, they were starting to really look for tools and services that would provide them with significant potential to be able to work collaboratively. So even though at the top level the national collaboration might have decreased in intensity and necessity, I think what we were seeing from the grassroots perspective [was] a greater need for services that would provide collaboration across boundaries. (Respondent C)

There may be many reasons why this may have been the case not the least of which could have been the fact that teachers were increasingly using the Internet and services such as Facebook and 'there was a need for something for educators' (Respondent C) said one respondent.

Personalisation offered more for educators, as one person suggested. 'Operating in the education domain, you are likely to share and find things which relate and are relevant to you (the teacher) more easily' (Respondent C).

Collaboration in EdNA projects that did not proceed

The EdNA project had a number of initiatives that did not continue for a variety of reasons. This section examines four of those initiatives from the perspective of collaboration to judge whether the strength of collaboration appeared to be a factor linked to their success or failure. The four initiatives discussed here are: telecommunications, the Higher Education Committee, Flexiblelearning.net and commercial materials on EdNA.

At the beginning of the EdNA project in 1995, one of the objectives was to work together collaboratively to harness telecommunications in order to nationally benefit education and training (DEET, 1995e). However, the work on telecommunications was discontinued after twelve months (DEETYA, 1996b). Then later during the EdNA project, sector advisory committees were established to bring a wider

perspective from the schools, training and higher education sector perspectives to inform the national EdNA discussions and influence the directions for EdNA's development. The schools and training advisory committees were successful as part of the EdNA initiative although that was not the case in higher education.

Another area of interest for the EdNA project was the development of a national online service for directory and information services for schools, training and higher education. Concomitantly, as EdNA's online services were developed for each sector, there was an expectation that each sector would contribute to EdNA's content links and utilise EdNA to deliver its national services. However, after a time the training sector developed their own online infrastructure and services which was independent of EdNA. Finally, the EdNA project gave serious consideration to linking commercial education and training materials to EdNA. In time, EdNA developed a service to host commercial training materials and services but it was discontinued twelve months after it began. Each of these EdNA initiatives has been examined in turn below from the perspective of collaboration with a view to understanding whether collaboration provided a stimulus or was a barrier to success.

(i) Telecommunications

When the EdNA initiative was begun in 1995, communications was raised as an issue that was confronting State bodies in the delivery of information and communications technology in education and training. Gibbons (1995a) stated:

A characteristic which is common to many current initiatives in applying information technology to education is their isolation from each other around Australia, a wide range of groups are confronting exactly the same issues - getting adequate communications access, negotiating communications tariffs.

(Gibbons, 1995a, p. 2)

Following consultations with the States, the Commonwealth prepared and distributed for agreement, a paper called the *Business Requirements Analysis* for Education Network Australia (DEET, 1995d). In that paper, which was agreed by State

Ministers, telecommunications bandwidth and costs (DEET, 1995d, p. 15) were highlighted for attention.

Then on 14th September, 1995, at a meeting of the EdNA Networking Business Requirements Reference Group agreement was reached (DEET, 1995h) to form a national negotiating team to take forward telecommunications issues for education. The role of the negotiating team was to consult with the telecommunications industry to try to gauge the potential for bulk national tariffing arrangements for education and then to inform States of the outcomes.

The Commonwealth, with the advice of the negotiating team, prepared a request to industry for a proposal to supply telecommunications at preferential tariffs and the negotiating team became an education telecommunications working party (DEET, 1995b). The request for proposal was distributed to industry for comment and responses received (DEET, 1995e). However, in the meantime, the States informed the Commonwealth that they had been instructed to comply with their own States' whole of Government telecommunications purchasing arrangements (DEETYA, 1996b). As a consequence, advised the EdNA Networking Business Requirements Reference Group that the request for a telecommunications proposal would not proceed (DEETYA, 1996b). Although telecommunications continued to be discussed by AICTEC members, it was for informational purposes.

Taking into account Rogers (2003) innovation-decision process as part of the telecommunications effort, it is evident that the knowledge and persuasion occurred as part of the negotiating team's and working party's work. Those engaged with the working party were self selected and committed to an advantageous outcome. However, the decision to adopt a national telecommunications arrangement was not forthcoming from the States and the so the work ceased.

Although the idea of gaining telecommunications preferential treatment for education seemed sensible and there was much good will to do that work the collaborative characteristics of common goals and mutual responsibility were not present because each State had been instructed to pursue other whole-of-State arrangements (DEETYA, 1996b). As a consequence the telecommunications effort was abandoned

because of the lack of a common goal and mutual responsibility which meant that there was no will to proceed and telecommunication arrangements for education became an insurmountable barrier.

(ii) Higher Education Committee

The formation of sectoral advisory groups was agreed by the Network Business Requirements Reference Group in January, 1996 (DEET, 1996c). This was followed by the formation of the EdNA Vocational Education and Training (VET) Advisory Group (DEETYA, 1996f). The inaugural EdNA Reference Committee (AICTEC) meeting (DEETYA, 1996c, 1996f) envisaged an advisory committee for each of the three sectors: schools, training and higher education. A chart was provided for possible EdNA advisory committees (DEETYA, 1996c) all of which would report to the EdNA Reference Committee (AICTEC). The EdNA School Advisory Group was formed some months later (NT Department of Education, 1996). The Commonwealth announced at the Inaugural ERC (AICTEC) meeting (DEETYA, 1996c) that funding for a project officer would be provided for each of the advisory committees.

The higher education sector had been very active and provided advice to AICTEC (formerly EdNA Networking Business Requirements Reference Group then ERC) through the participation of an university technology expert. However, there was not an higher education group to provide input to AICTEC until late in 1997 (DEETYA, 1997b) when a group was brought together, for the first time, by the higher education technical expert with the support of the Commonwealth. The higher education sector had already been funded for a project officer (DEET, 1996c) to develop mechanisms for consultation within the sector and to provide input and feedback to the EdNA project.

The result was the formation of the Higher Education Advisory Group (HEAG) although it lapsed after another three meetings and moved towards project work that harnessed the technical expertise of the higher education sector. A project of note was the development of the EdNA Metadata Toolsets (Currie et al, 2000) for use in

extracting web based metadata automatically from web-based content and uploading it to EdNA packaged with the content.

Taking into account Rogers (2003) innovation-decision process, the knowledge and persuasion stages would appear not to have happened. The characteristics of collaboration would also appear to have been absent especially shared leadership, common goals, shared process and framework, shared decision making and mutual responsibility. These five characteristics which encompass commitment were not evident in the documentation relating to HEAG. However, a group called the Higher Education IT Consultative Forum, an advisory group to the ERC (AICTEC) was formed in 1999 and it developed a position paper for AICTEC about *The Way Forward* (Education.au Limited, 2002c) in the higher education sector. The researcher could not find any evidence that this group continued beyond the preparation and approvals for this paper although the leadership of universities was noted in the statement,

Universities are early adopters of commercial computer applications, using them for administrative, research and teaching purposes. E-mail was used by academic staff well before its broader acceptance. Spreadsheets and office applications are widely used, and statistical and other packages are frequently tested within universities at an early stage. (Education.au Limited, 2002c, p. 2)

It is not difficult to understand that the higher education sector was not persuaded to engage with AICTEC in 1999, particularly as the higher education sector had pioneered the Internet in Australia.

(iii) Flexiblelearning.net

The formation of the EdNA VET Advisory Group (DEETYA, 1996f) saw the beginning of the EdNA VET Directory Project, the purpose of which was to develop an EdNA VET directory structure, identify content sources, establish guidelines for selecting content and develop quality assurance procedures (DEETYA, 1996f). The means of communications for the group was by using an EdNA email distribution list

and a website on EdNA (<http://www.edna.edu.au/vetwp>) for the publication of VET information and news.

The work of the EdNA VET Advisory Group (EVAG) was broadened with ANTA participation and funding looked beyond the work of EdNA in 2001 (Flexible Learning Advisory Group, 2009). The new group called the Flexible Learning Advisory Group (FLAG) became involved in VET flexible learning issues apart from the EdNA project and so the need for an online presence for the work of FLAG arose. However, instead of using the EdNA domain name for online collaboration, a new domain name for FLAG was registered at www.flexiblelearning.net.au and a specialist website developed for the purpose.

An elearning framework, known as the Australian Flexible Learning Framework, was developed in 1999 as the elearning strategy for the VET sector. It was funded specifically for the VET sector by the Commonwealth through the Australian National Training Authority (ANTA) for the five year period 2000 to 2004 (Australian National Training Authority, 2001). The funding and the specific VET focus managed by ANTA strongly influenced the innovation-decision process. FLAG (formerly EVAG) as the body responsible for providing advice on the framework developed its own web service and to a large extent remained independent of EdNA (Australian National Training Authority, 2001, 2005; Australian Government, 2007).

The characteristics of collaboration in relation to EdNA were not evident in the documentation for the FLAG funded projects as they were VET specific. However, cooperation did occur between the VET sector and EdNA as required by the Commonwealth under contracts to engage with EdNA (Flexible Learning Advisory Group, 2009). This cooperation was for some VET news services and selected web site information of a general nature.

(iv) Commercial materials on EdNA

The thinking about linking commercial materials to EdNA occurred in several documents. It began with the original issues paper (DEET, 1995b) which was followed by the EdNA Business Requirements Analysis (DEET, 1995d) and then a more detailed analysis by the OLTC (1996) EdNA Business Plan reporting on the activities of the OLTC Billing Taskforce. These reports culminated in the formation of a Commercial Materials Working Party that requested Education.au, then called OLTC, to develop a classified advertisement facility on EdNA (DEETYA, 1997b). The plan was developed and approved as the *Business Plan for Classified Advertisements External to the EdNA Directory Service* (OLTC, 1998).

The implementation took place by OLTC engaging an outsourced partner and sponsor that developed a service called *edna.com* which was linked to EdNA. Developed under joint management by OLTC and the outsourced partner, this new service made available facilities to access online commercial courses, online educational materials and educational services, especially focussed on the VET sector (OLTC, 1998). When the service launched in July 1999 (Education.au, 1999c) CEOs of schools, training and higher education were invited to populate the new service with their courses, materials and services, including employment advertisements, for public access. The new service was to act as a brokerage. However, after twelve months a strategic review of *edna.com* was initiated because of slow content population and poor user take up (Education.au, 2000b). The review, when completed in October 2000, reported marginal gains for *edna.com* in the future and so the Board of Education.au agreed suspended the service (Education.au, 2000b).

The knowledge component of Rogers (2003) innovation-decision process for the initiative came with a feasibility study commissioned by AICTEC and the persuasion and decision aspects occurred as part of the deliberations (DEETYA, 1997b) of AICTEC (formerly ERC) in developing an issues paper, business plan, consultancy feasibility report and then requesting that Education.au develop the service for use by the schools, training and higher education sectors. However, the sectors did not

populate the service when the website had been completed, so that it became a facility without content. The implementation of the service by the education and training sectors did not happen and confirmation of the decision to support the service was not forthcoming and so the service failed (Education.au, 2000b).

The characteristics of collaboration can be argued to have been present throughout the knowledge and persuasion stages of innovation-decision making when the feasibility, planning and development of the service took place. Evidence of shared leadership, common goals, shared processes and framework, and shared decision making were evident in the documentation of the committees and working parties (OLTC, 1998). However, mutual responsibility was not evident once the website service was launched and the onus was on the sectors to contribute. This could suggest that collaboration was useful when a new and common issue confronted the education and training sectors, as a way of gaining awareness, knowledge and insights.

Summary of EdNA projects that did not proceed

In the four projects mentioned above, that did not proceed as part of the EdNA project, Rogers (2003) innovation-decision process was suspended at some stage for a specific reason as was collaboration amongst the stakeholders. The telecommunications project did not proceed beyond the initial decision making stage and in terms of collaboration the States and Commonwealth did not share a common goal. The higher education project did not appear to proceed beyond the persuasion stage although coordination by the EdNA higher education project officer did occur when the project was initiated. The higher education sector moved to project coordination following funding by the Commonwealth to develop a metadata tool. The VET sector website was consistent with the innovation-decision process within the sector although collaboration with other sectors was minimal. Collaborative characteristics such as mutual responsibility and open communication as part of the EdNA initiative were not apparent. Indeed, it appeared that the VET sector cooperated with EdNA only when it was mutually beneficial to do so.

The innovation-decision process for the *edna.com* service was consistent with Rogers (2003) theory until the service was developed. However, confirmation for the *edna.com* innovation was not forthcoming from the States who failed to populate the site with local content even though that had been agreed when the service was initiated and developed. The development of the *edna.com* service demonstrated many of the characteristics of collaboration in the initial stages although mutual responsibility did not occur when the service was being implemented. What was common with each of these projects was that the innovation-decision process did not proceed to confirmation and the characteristics of collaboration, especially shared and common goals and mutual responsibility, were not present in the documentation which is also consistent with the researcher's recollection.

Collaboration in EdNA peak periods

In the previous chapter the growth and take up of EdNA were examined by population take up and a number of peak usage periods were identified. The innovation-decision process was commented on for each peak period and an examination of the events leading to those peak periods followed. The analysis of the peak periods has been extended further below by examining the presence of collaboration as evident in the documentation, as reported by the interviewees and from the researcher's recollection. The examination of these is presented here in chronological order.

April 2002

The lead up to the Global Summit 2002 was in progress in October, 2001, with information being continually distributed via stakeholder newsletters and through use of the EdNA Forums where discussions about proposed speakers for the Global Summit had been canvassed (Education.au, 2001b). In addition, a new user interface, after consultation with stakeholders, had been developed and released, and comments invited (Education.au, 2001c). Another event that affected the use of EdNA, at that time, was a strategic alliance with a successful schools-based Internet company that

gave additional promotion in schools to EdNA and the Global Summit (Education.au, 2001c).

The momentum of the previous year's activities continued into 2002, with the addition of alliances with the World Congress of IT, being held locally in Australia, plus alliances with other national and international bodies (Education.au, 2002d), all of which helped with the promotion of awareness of the EdNA service. The traffic on EdNA did increase during the period of the Global Summit in March, 2002, as stated in the EdNA report to the Board:

The traffic in the first two months of 2002 was a ten-fold increase in the traffic over the last two months of 2001. (Education.au, 2002d, p. 2)

However, the Global Summit and the alliances were initiatives of Education.au, through consultation with the Board as opposed to being part of a national collaboration. These activities can be seen as information distribution and promotion of EdNA to stakeholders locally and to users generally.

During 2002, consultation about the direction and development of EdNA had taken a different course of action because of the wider interests of the former advisory groups. As stated in the *EdNA Online, Education Portal and Sibling Sites* (Education.au, 2002d) report:

The consultation process for the strategic development of EdNA Online included the EdNA Development Workshop (held in February) and the EdNA Online Roadshow held during April, May and June. Each state and territory was consulted in regard to the priorities for EdNA Online for the forthcoming year. During the road show a number of key issues for EdNA Online were identified. (Education.au, 2002d, p. P. 1)

In addition, Education.au began to develop websites that utilised the EdNA core software but was designed with different interfaces and functionality, so that these new websites had a different look and feel to that of the main EdNA interface. These websites, running from core EdNA software were called sibling sites, the first of

which was the Australian Education Portal (Education.au, 2001c). Several other sibling sites were developed in a short space of time, some built using the EdNA database and others linked to the EdNA database. These sibling sites significantly increased traffic to the EdNA service (Education.au, 2002d, 2002e, 2002f).

The innovation-decision making processes for these activities occurred within Education.au who consulted with AICTEC or other national bodies such as the sectoral advisory groups and comments were invited. The nature of collaboration with stakeholders would appear to have changed, during this time, as the advisory groups sought to address wider issues of interest and delegated the development and management of EdNA to Education.au. As one interviewee said, 'National collaboration from the early 2000s, wasn't as strong. It was diminished' (Respondent C).

May 2003

Throughout the latter part of 2002, Education.au proceeded to develop a collaborative workspace on EdNA and the EdNA service moved from being a 'retail' model to a 'wholesale' model of service (Education.au, 2002g). That is, the effort to develop sibling sites utilising the EdNA database of resources and EdNA applications in order to provide a different and customised view of EdNA for specialist purposes increased as did the number of users. EdNA had become more than a place to visit on the Internet and now also enabled stakeholders to use much of EdNA's application software and also access and use its database (Education.au, 2003a). The online collaborative community workspace continued and users had a new facility called MyEdNA in which to customise their own use of the service. The sibling sites, collaborative workspaces and customised service resulted in an increase in the usage of EdNA (Education.au, 2003a).

Again the innovation-decision process occurred within Education.au through consultation with the States and endorsement by the Education.au Board with approval for funding by the Commonwealth (Education.au, 2003a). The process that was evident in the documentation would appear to have changed to leadership by

Education.au and consultation with the stakeholders in order to innovate with EdNA. However, the characteristics of collaboration were not evident among stakeholders.

May 2004

A year later, Education.au had developed a concept to access large databases or repositories through EdNA. This new service, a federated search facility called the Distributed Search Manager (Putland, 2003), enabled the EdNA service to be used as a gateway to large international databases of educational resources. The EdNA portal was redesigned to accommodate this new environment of access to international online resources and launched in August, 2003. Users of EdNA were made aware of this enhanced EdNA search service through the distribution of online newsletters and other awareness raising activities in the latter half of 2003 and early 2004. The newly designed EdNA portal service now included 'personalisation, customisation, federated searching and collaborative workspaces' (Education.au, 2003b) and usage increased to a peak in May 2004.

The innovation decision-process continued to be lead by Education.au through consultation with national groups of ICT leaders in events such as the EdNA Development Workshop (EDW). In early 2004, the innovation decision stages occurred through consultation and workshops with the States (Education.au, 2004d) and usage of the service, with many new features, peaked in May 2004. The characteristics of collaboration were not evident in the documentation although the use of network intelligence emerging from the EDW and throughout the consultations with the States was evident (Ithaca Group, 2004). This process could be seen as one of coordination with consultation and promotion, and Education.au leading innovation of the EdNA service, but the characteristics of collaboration were not present.

June 2005

The next peak in usage occurred in June, 2005, which followed a period of intense usability improvements for EdNA, undertaken through extensive national consultations with users. The improvements were an upgraded and enhanced search facility, the addition of a number of large repositories that could be searched through EdNA, a single sign-on access to all of EdNA's collaborative and shared services, and significantly a major upgrade to the group collaborative facility (Education.au, 2005c; Education.au, 2005d; Education.au 2005e). That upgrade was important because the group collaborative facility became an avenue for online collaboration. As one interviewee stated:

Collaborative tools enabled EdNA staff to work with a range of different parties. [There was] less contact direct with jurisdictions, although that was still important, but much more contact with practitioners (users). (Respondent A)

Two additions to the consultative approach were made by Education.au to enhance network intelligence and engage a wider group of EdNA users in the planning processes. The first was the establishment of a network of EdNA users (Education.au, 2005d) to provide feedback of intended changes and secondly, a national invitation was distributed canvassing written submissions for improvements to the service or to comment on planned improvements for the service (Education.au, 2005g). Although the submission process was a form of consultation, the online feedback service encouraged collaboration among users and EdNA developers.

The innovation-decision process continued to be lead by Education.au, with consolidated reports of consultations with the States reported to the ERC (formerly EORC), then recommendations to the Board and finally, approval for funding by the Commonwealth. There is some evidence that an increasing number of characteristics of collaboration were emerging with the online services. Characteristics such as change resilience, network intelligence, flexibility and responsiveness, open communication and diversity in thinking, and appropriate levels of technical competence were apparent in the online feedback groups. However, other characteristics of collaboration such as shared leadership, common goals, shared

process and framework, shared decision making and mutual responsibility were not evident in the documentation. Users contributed to the conversations but were not equal partners in the development of EdNA. The processes at this stage of EdNA's development were consistent with a coordinated approach which was lead by Education.au. 'What we were seeing here was an increasing level of sophistication by the users to want to work online and to work in a collaborative way' (Respondent B) said one respondent.

May 2006

The launch of the new EdNA Groups in June 2005 (Education.au, 2005b) added momentum to the take up of EdNA services throughout 2005 and early 2006. As stated to the ERC, EdNA experienced:

Unprecedented growth (1000%) in cross-sector and cross-jurisdiction professional collaboration through 500 EdNA Groups (online communities), based upon a customised implementation of the open source Moodle⁸ learning management system application (Education.au, 2006a, p. 4)

This increased take up of EdNA can be attributed to the implementation of EdNA Groups promoted through newsletters and over 80 face to face workshops throughout Australia (Education.au, 2006a). The innovation-decision process was a continuation of the consultative approach led by Education.au discussed above for June 2005. Although some characteristics of collaboration were evident in the documentation, similar to that for June 2005 above, the approach remained consistent with a cooperative process with consultation.

November 2006

In October, 2006, Education.au led an international symposium called the Global Summit 2006 which was described by the organisers as a 'conversation and

⁸ www.moodle.org

networking event for educational leaders concerned with using ICT to improve learning' (Education.au, 2009c, p. 1). The lead up to the Global Summit saw a campaign of promotion and advertising for the event by Education.au (Education.au, 2005f; Education.au, 2006b) at the very time when the services provided by EdNA were well used and included online discussion and community building capacity with EdNA Groups, EdNA Shared Information Services (lists, forums, news) and the customised MyEdNA service accessed through a single sign-on facility (Education.au, 2006b).

The innovation-decision process for the take up of EdNA services leading to this peak of usage in November appeared to be integral to the Global Summit. That is, the organisers expected EdNA's services to be an integral part of the Global Summit and used them throughout the event as the researcher recalls and as one interviewee said, 'there were about 1500 to 1600 online communities' (Respondent A). Although the Summit website was part of the Education.au website, the capacity of EdNA's services enabled community building and collaboration. An example of EdNA's usage for the Global Summit was the pre-Summit discussion groups leading to the Summit (Education.au, 2006c). Another example of using EdNA for the Global Summit was the use of the EdNA Groups' wiki for collecting and collating group discussion comments throughout the Global Summit, as the researcher recalls.

Although collaboration occurred as part of the pre-Summit event as well as during the Global Summit 2006, the characteristics of collaboration for the take up of EdNA were not explicitly evident in the documentation of the Global Summit because it was an event led and managed by Education.au. However, EdNA was cited in the planning documents (Education.au, 2006c) and its facilities were used as an available online infrastructure. EdNA's facilities were upgraded prior to the Global Summit to include facilities such as blogging, podcasting, tagging, messaging and other so called Web 2.0 features, and EdNA Groups was also enhanced (Education.au, 2006d). Online collaboration, sharing and commenting among users was a feature of the Global Summit which did enhance the take up and use of EdNA although the Global Summit did not purposely contribute to the development of EdNA. EdNA recorded higher usage during the Global Summit than at any other period in its

history although attributing the higher usage to online collaboration rather than promotion would be difficult.

August 2007

In the period leading to the small rise in EdNA usage for August 2007, a number of improvements to the EdNA service were noted. An experimental site was developed on EdNA for users to trial new functionalities such as applications for mobile phone services and further developments to improve personalisation (Education.au, 2007b). In addition, the number of major Australian databases that were enabled to be searched using EdNA increased from six to nine (Education.au, 2007c) with further additions planned. Usage of EdNA Shared Services continued to increase as did usage of EdNA Groups (Education.au, 2007d).

However, the innovation-decision making processes used by Education.au to consult with stakeholders about the development of services for EdNA continued as before. They occurred through consultations at the EdNA Development Workshop at the beginning of the year, discussions with the ERC, then workshops in the States, feedback from the new trial 'sandpit' service and EdNA Friends group, newsletters for promotion, recommendations to the Education.au Board and approval by the Commonwealth for funding. Although this consultative and communications process did reflect some characteristics of collaboration, such as, change resilience, network intelligence, flexibility and responsiveness, open communication and diversity in thinking, and an appropriate level of technical competence, other characteristics of collaboration such as shared goals, agreed framework and mutual responsibility were not evident. This position is consistent with Himmelmann's (1993) description of coordination.

March 2008

A peak in usage occurred in March 2008 which corresponded with the months after the near final release in November 2007 of the new Web 2.0 based MyEdNA service.

The MyEdNA service, fully released in May 2008, enabled users to post and share their profiles as well as form communities based on personal interests from posted profiles (Education.au, 2008f). This new mature MyEdNA service renamed as *me.edu.au* attracted considerable online attention with 8850 profiles in the six months before the full launch (Education.au, 2008d). In addition, users were invited to trial the new services which included a conferencing tool, an eportfolio service for online curriculum vitae and social networking spaces (Education.au, 2008e, p. 12). The developers of EdNA used the feedback from the users group of EdNA Friends, who were trialling the new services, to modify and refine each service within the resource constraints (Education.au, 2008g).

The innovation-decision process was similar to the previous year with Education.au leading innovation and consultation processes. Stakeholders gained their knowledge of *me.edu.au* and were persuaded to use *me.edu.au* by Education.au promotions such as newsletters, workshops and meetings (Education.au, 2008e). Some characteristics of collaboration were present in the documentation although they did not vary significantly from the previous peak usage periods and more fully represent cooperation rather than collaboration. However, the emergence of collaboration among the users who trialled the new EdNA services was noteworthy. As one interviewee remarked, 'Collaboration is now not at the macro level. It starts off at the macro level. There are now a series of micro collaborations' (Respondent F).

Summary of peak periods

The peak usage periods outlined above occurred in a period of change in the innovation decision processes for EdNA, at a time when the advisory groups sought to be engaged in a wider technology-in-education agenda than a single focus on EdNA. This enabled Education.au to lead a consultation process that did include some of the characteristics of collaboration although the process as defined by Himmelmann (1993) would be coordination based on consultation.

The peak periods of EdNA usage occurred as the result of promotions. Consultations were undertaken through an ideas workshop, State consultations, online engagement

and discussion with users, trialling of new services by users and an innovation decision process that occurred through the ERC, the Education.au Board and the Commonwealth. What is noticeable throughout this period is the level of innovation in the development of EdNA through the online collaboration of users and the engagement of testers indicating that innovation was related to collaboration among the users. However, collaboration among the stakeholders would appear to have been directed at developing policies and procedures. There would appear to have been limited strength in collaboration among the States as EdNA's services developed and matured. However, quite the opposite would appear to be the case for online collaboration. The strength of online collaboration among users engaged in developing new EdNA services was evident.

Summary of chapter

This chapter has presented an analysis of collaboration associated with the development of EdNA in three ways focussed on firstly, the five phases of EdNA, secondly, the projects that did not proceed and, thirdly, the peak periods of EdNA identified by usage.

Collaboration would appear to have been strong in the initial establishment phase of EdNA when the characteristics of collaboration were evident in the documentation, commented upon in the interviews and consistent with the recollections of the researcher. This collaborative nature of the EdNA project continued into the development of the EdNA directory service until 2001 when the national and advisory groups broadened their focusses to work on issues about educational technology wider than EdNA. The process for the development of directions and innovation for EdNA moved to a consultative mode and ranged from cooperation to coordination by Education.au.

The analysis revealed a variety of impediments associated with EdNA projects that did not proceed. However, the common element that was not present in all cases was that of collaboration. Although some of the characteristics of collaboration were

present at some stages in each project, they could not be said to have been fully collaborative. Thus, failure may well have been linked to the lack of collaboration.

The events leading to and immediately following EdNA's peak usage periods showed the emerging leadership of Education.au to consult widely about EdNA's directions and to be innovative in their approach. However, the strength of collaboration with and among the States about EdNA would appear to have been minimal. Where collaboration was strong in the establishment of EdNA, as seen in chapter 6, that would not seem to be the case as the number of users increased and the EdNA service developed beyond the year 2000.

The peak periods have also shown that users responded to high levels of promotion and publicity about technical EdNA innovations and new online services about which an increasing number of users were engaged through online collaboration. The emergence and strength of online collaboration would appear to be an important aspect of the innovation and development of EdNA from 2004 onwards.

Chapter 8 Discussion of findings

What the research study set out to do

This study set out to advance understanding of the diffusion of ICT in education through the building and testing of theory and the role of collaboration on the diffusion of ICT in education. The research was a case study (Coleman and Briggs, 1999; Yin, 2003; Denzin and Lincoln, 2003; Crewsell, 2007) of the innovative and globally acknowledged online education portal service Education Network Australia (EdNA), and given that collaboration was seen as fundamental to the initiation and development of EdNA, the research placed a special emphasis on the role of collaboration in the diffusion of ICT in education.

EdNA case study

The research began by developing a chronological history of EdNA, spanning the whole 14 years of its operation, from 1995 to 2009. As indicated in Chapters 2 and 4, the chronology was based on a wide-ranging and extensive document search process. The chronology paid particular attention to the antecedents and take up of the innovation by the stakeholders, who were inter alia the owners, as well as users of the service. Attention in the chronological history was also paid to collaboration among stakeholders as well as collaboration among users of the service.

The chronology took account of the global and Australian education and technology environment in which EdNA was initiated and developed. It was noted that although computers had been used in schools as stand-alone devices since the early 1980's (Shears and Dale, 1983) and school education authorities had included technology in the Australian goals of education through the Hobart Declaration in 1989 (MCEECDYA, 2009c), it was the invention of the World Wide Web (WWW) in 1989 (Gillies and Cailliau, 2000) that enabled computer networking and connectivity

on an unprecedented scale. Education authorities were keen to take advantage of this networking.

Document search and analysis established that a national education and training agency OLTC was created in 1993 to network technology (Hesketh et al 1996) and then restructured to manage EdNA (MCEETYA, 1996a, 1996b) in 1997, and renamed Education.au in 1998. This research found that an unprecedented level of concern to integrate technological skills into Australian education, at all levels was a catalyst for collaboration in education, on a scale previously not seen, among Commonwealth and State education authorities. This level of collaboration built on and extended existing national structures for cooperation, and appeared to establish an expectation and understanding of collaboration as a value and a practice that persisted throughout the initiation phases of EdNA, and it stimulated the development, management and innovation of EdNA beyond its establishment. The chronological history highlighted the collaboration among stakeholders and indicated how collaboration was prominent in the development and take up of EdNA apparently enabling the stakeholders to participate, contribute and comment on the plans and progress of the development of EdNA.

The chronological history examined in some detail the five phases of the development of EdNA from its initiation in 1995 to the development of a directory service of evaluated resources in 1996 and the introduction of shared information services also in 1996. Subsequently, these shared information services were further enhanced in 2004, followed by online group services in 2005 and then personalisation services for users in 2008. These innovative online services introduced on EdNA could be seen to have paved the way for the States to further develop their own online education services. In fact, in 2005, as a part of the EdNA shared information services, a number of software portal applications were provided for the States to integrate into their own online education services, to enhance their capacity and functionality for State online education users.

The chronological history developed as part of this research provided a detailed review of the events leading to the establishment of EdNA, the processes used for the initiation, development and management of EdNA and the impact that EdNA had on

education. In its own right, it is a significant contribution to scholarship because hitherto the ground breaking impact on education in Australia made by EdNA has not been closely examined or analysed.

Theory building and testing methodology

In Chapter 3, a new theory of diffusion of ICT in education that emerged from the literature review was proposed. That theory was tested in three ways as outlined in Chapter 4. Firstly, the attributes of the likelihood of success of an innovation as argued by Rogers (2003) and enhanced by Wilson et al (2000) were examined together with the level of influence of the decision making during the initiation and establishment period of EdNA. Secondly, the rate of take up of EdNA was analysed by examining uploaded content, then plotting EdNA page-view statistics and then peak usage periods were identified. Thirdly, the characteristics of collaboration were examined for each of the phases of EdNA's development and the peak usage periods. Finally, the perspectives of a number of key players and the recollections of the researcher were included to strengthen the documentation research and analysis.

Theory of diffusion of ICT in education

The first research question was:

How do theories of diffusion of innovations (e.g. Rogers, 2003) and frameworks for collaboration (e.g. Rosen, 2007; Education.au Limited, 2004a) inform the development of theory on the diffusion of ICT in education?

This question has been explored in detail in Chapters 3 and 4, and the findings are discussed below.

As indicated at the outset of this thesis, the literature search revealed very little in the way of theories of the diffusion of ICT innovations in education. This research therefore applied Rogers' (2003) theory of diffusion of innovation to the study of

EdNA as an ICT innovation in education. Rogers (2003) used the term diffusion to mean both the spontaneous and the planned spread of new ideas, and argued that the likelihood of innovation could be judged by a number of antecedents such as relative advantage, compatibility, complexity, trialability, observability and reinvention or modification. This research added the further factor of 'support' for an innovation put forward by Wilson et al (2000). The seven antecedents were then examined to determine the likelihood of EdNA as an ICT innovation in education being successful.

Rogers (2003) argued further that the adoption of an innovation could be shown by graphing the population take up of the innovation by its users, over time. This research analysed the take up of EdNA throughout its five phases of development which were:

- The initiation phase 1995 to 1997
- A directory service of evaluated resources 1996 - 2009
- Shared Information Services 1996 - 2004, 2005 -2009
- Group collaborative services 2004 - 2009, and
- Personalised services 2007 – 2009.

Finally, Rogers (2003) theory of diffusion of innovation detailed the strength of influence of the social and communication systems within the organisation in which an innovation occurred. This research, in applying Rogers (2003) to the diffusion of ICT in education, developed a theory based on the position that the social and communication systems in education were essential to professional learning in education (Timperley et al, 2007) and professional learning involved collaboration. A definition of collaboration for education was developed from the literature to test the role of collaboration on the take up of EdNA. In this research, as indicated in Chapter 3, collaboration in education was defined for the first time.

Collaboration is the process of co-creating knowledge while sharing physical or virtual space.

As previously stated, this definition of collaboration took into account the dynamic process of creating knowledge consistent with the purpose and culture of education as well as the process of sharing and working together online and offline.

Combining Rogers (2003) theory of diffusion of innovation with the newly developed definition of collaboration in education in this research, led to the proposition, developed in Chapter 3, that:

The successful diffusion of an ICT innovation in education can be assessed by its antecedents, its rate of population take up and the strength of collaboration associated with its development and use.

A discussion of the findings from testing this proposition follows.

Testing the theory of diffusion of ICT in education

The second research question was:

How does the application of this emerging theory to a case study of EdNA assist understanding of the critical success factors and barriers in the diffusion of ICT in education and further inform the development of the theory?

This question has been explored in detail in Chapters 5 and 6, focussed respectively on the antecedents and population take up of EdNA. The findings are discussed below.

Antecedents – critical success factors and barriers

The antecedents of the likelihood of success of an innovation used in this study were *relative advantage, compatibility, trialability, observability, complexity, support and modification or reinvention*. In terms of these antecedents, there is convincing evidence that EdNA was regarded as a relative advantage by the Commonwealth and States which was evidenced by their willingness to engage in a national collaboration

to develop the service for mutual benefit. The EdNA initiative was regarded as compatible with existing education values as can be seen by the extensive consultation undertaken by the Commonwealth to ensure that the States' needs were met. EdNA also had the capacity to enhance education through online resource sharing and by avoiding duplication of effort in the States.

However, there was little in the way of trialability of EdNA because the initial development was undertaken by the Commonwealth although the States were kept fully informed of the progress of building EdNA and constant feedback was actively sought and taken into account. The level of influence remained clearly with the Commonwealth which organised and chaired meetings as well as drafted records of meetings for review by the States, prior to their final distribution. Observability of Internet innovations is notoriously difficult because the Internet and WWW are electronic media and visually accessible only through a screen or a projector. EdNA was no different. Much of the progress of EdNA was reported through printed versions of screen-shots and hard-copy distribution of policies that were developed for the deployment of EdNA in education. In fact, the development of EdNA was also technically complex because it was developed as a website that accessed a database of resources. Database driven websites were not common in Australia at that time and in fact, EdNA was the first database driven website in Australia, as well as in education, so an understanding and appreciation of the progress of building EdNA was not a simple matter to communicate to the States. The innovation decision process (Rogers, 2003) was entirely focussed on the development of policies, checking national meeting records and being informed of the building progress of EdNA. The three factors mentioned here trialability, observability and complexity appeared to act as barriers to the development of EdNA. Certainly, an understanding of EdNA beyond those State officers immediately involved in the collaborative efforts to develop the service was not apparent. This was emphasised by one respondent, who, when asked, 'Was collaboration strong?' said:

I believe there was collaboration between the people who participated in the national meetings and the people who represented their systems at national meetings. The answer to that was 'yes'. I believe that some of those people met a lot of resistance when they then went back into their respective organisations.[which were] education departments. (Respondent E)

There was strong support from Ministers of education and senior officers from the Commonwealth and States for the development of EdNA. There was a high level of influence and leadership which enabled Commonwealth and State representatives to physically meet on a national basis over a period of years to develop plans, policies and protocols. However, the capacity for user modification and reinvention which Rogers (2003) argued assisted diffusion so that the adoption was more likely to be sustained was not evident in the establishment and development of EdNA, in its initiation phase, although stakeholders as users were kept informed of technical implementation progress.

Based on the documentation and key stakeholder accounts, the likelihood of the success of EdNA as an ICT innovation in education could not be argued to have been assured. However, the strength of leadership by the Commonwealth and the active collaboration of the stakeholders helped to sustain the initiative in the establishment phase through goodwill and an eagerness by the States to understand the new technologies and their application to education.

The theory of ICT innovation in education proposed in this research and restated above reveals a number of barriers for the success of EdNA as an innovation. In this analysis, these barriers are framed around the concepts of trialability, observability, complexity and the capacity for reinvention or modification of the initiative. However, the relative advantage, compatibility and support for the initiative were strong as was the leadership by the Commonwealth and the goodwill from the States to share their understandings and experiences in applying the WWW to benefit education nationally and locally.

Rates of adoption - critical success factors and barriers

Rogers (2003) theory of diffusion of innovation moved beyond the antecedents to examine the pattern of take up by users of the innovation. Rogers (2003) noticed that over a period of time that the take up of a successful innovation could be graphed by its population of users over time and that the graph always reflected an S-shaped

curve. The slope of the gradient of the S-shaped curve indicated the time over which an innovation was adopted.

This research graphed the take up of EdNA by its users over time for each EdNA service from the year 2000 when reliable and consistent access statistics were kept. Prior to 2000, statistics on the number of linked content resources loaded onto EdNA were considered important by the stakeholders. From early 1997 until October of the year 2000, the number of content links, with accompanying metadata for each, that were loaded onto EdNA for access by education users, increased from just over 1000 items to nearly 15,000 items. There was a concerted effort by the Commonwealth and the States together with Education.au to populate EdNA with quality online education content links. In addition, in the year 2000, Education.au deployed an EdNA robot to automatically harvest selected online portals for relevant education content links to be uploaded onto EdNA (Education.au Limited, 2001a). The harvested resources could be accessed only by the EdNA search function because they only contained minimal metadata. At its peak the number of linked resources from harvesting numbered nearly 1.5 million items (DEST, 2005) of unknown quality but from the databases of reputable education institutions.

The take up or use of EdNA services followed a broadly predictable monthly pattern with very high accesses consistently in March and May of each year followed by June, October and November. This can be accounted for by noting that most search and browse accesses came from school sector users, as noted by the Internet Protocol (IP) addresses from which the accesses originated. Accesses continued to increase from the year 2000 until 2005, for the search and browse functions of EdNA to locate online resource items, after which time there was a marked decline. This can be accounted for by the deployment by Education.au in 2005 of EdNA applications downloaded by the States for implementation in their own portal services. Measurement of EdNA accesses from State services was not possible although it was reasonable to predict that search and browse accesses of EdNA items did continue to increase as the use of the Internet in education became more common. However, EdNA search and browse accesses remained predominantly from school sector users.

The introduction of EdNA Shared Information Services, in 2005, utilising distributed portal software applications, syndicated news feeds and an improvement in listservs saw a dramatic increase in users from approximately 10,000 in 2005 to over 100,000 in 2008. The familiarity of the Internet and its increasing acceptance in education could be argued to have had an effect on the increased use of EdNA. However, the capacity for online collaboration among educators and notification of news and research information are more likely explanations, as will be seen below.

Towards the end of 2004, EdNA released a service called EdNA Groups which was an implementation of the interactive services that had become popular with the so called social media (Web 2.0) applications of the WWW. The full service was released in March of 2005 which experienced rapid growth to over 16,000 groups by December 2007. This trend continued until mid-2008 when the number of groups and members fell away as personalised services were introduced. Again, a new service, this time EdNA Groups, harnessed the latest Internet applications through EdNA for educators and had a rapid rise in usage for a period. EdNA Groups increased the capacity of educators beyond the functionality of email and listservs, and for educators to work together and to create knowledge while sharing virtual space. However, for the first time, the number of EdNA users of a new service were dominated by users from the training sector who outpaced users from the other two education sectors (schools and higher education). This can be accounted for by the fact that online training sector users were experienced with the collaborative group software implemented on EdNA. In addition, the training sector's funding for online collaborative professional learning was discontinued (Flexiblelearning.net, 2005), so their existing collaborative groups moved to use EdNA's services.

In 2008, EdNA introduced personalised services called *me.edu.au*, which had been experimental as MyEdNA since 2005. This new personalised service enabled users to network socially and professionally by their profiled interests. In many ways *me.edu.au* was an extension of EdNA Groups but it required less time to use and engage with others. As one interviewee said:

EdNA Groups has got very strong functionality ... but it does take a strong investment in time from the owner or the member to gain full value.

(Respondent A)

Me.edu.au is a simpler service so that educators are 'not making a big investment initially ... to become involved' (Respondent A). The take up of *me.edu.au* by educators was also quite rapid with 5,000 educator profiles at the launch of the service in February 2008, to over 16,000 in June 2009. The strength of the take up can be attributed to the personalised nature of the service as well as its capacity for users to network socially and share resources, content and tools. Another factor which led to the rapid take up was the fact that when *me.edu.au* was being developed, over 4,000 EdNA users (Black, 2008) were contributing to its development or commenting on its developmental progress. The level of online collaboration in the development of *me.edu.au* was strong as will be seen later in this chapter.

Although the combined accesses to EdNA services have continued to improve overall, as can be seen in Figure 6.13, and although the take up of each service did follow an S-shaped curve for a period, there is a pronounced decrease in the use of EdNA services as new technologies came into play or as users rationalised their use of time with online services. As can be seen above, search and browse accesses decreased after 2005, Share Information Services usage decreased in late 2008, usage of EdNA Groups decreased in May 2008 and *me.edu.au* usage decreased in November, 2008. The usage of each EdNA service peaked and then moved to a lower usage level. This raises questions about the sustainability of EdNA services after each service has reached the peak of its S-shaped adoption curve.

A number of outstanding peak usage periods from September, 2000, through to July, 2009, were also identified in order to determine whether collaboration was a factor that was associated with a sharp increase in the adoption of EdNA services. This is discussed in some detail below.

Collaboration - critical success factors and barriers

The third research question was:

To what extent does collaboration appear to be a critical success factor or otherwise?

This question has been explored in detail in Chapter 7 and the findings are reported below.

Collaboration encompasses the social and communication systems that Rogers (2003) argued were necessary to influence the adoption of an innovation. In the diffusion of ICT in education, collaboration has been fundamental to the professional communities that have been engaged in the development and management of EdNA at various times. The professional communities that have collaborated for the benefit of EdNA have occurred in both physical and virtual spaces.

During the initiation and development of EdNA, the characteristics of collaboration (*shared leadership, goals, processes, decision making, change, intelligence, flexibility, communication and diversity in thinking and an appropriate level of technical competence*) were clearly evident at different times, as was reported in Chapter 7. During the initiation phase of EdNA, Commonwealth leadership brought the States and education sectors together for a common purpose to share resources using EdNA and to develop policies for the implementation of EdNA. Collaboration about the vision for EdNA occurred with the States, business plans were developed and adjusted through feedback from education system stakeholders and decision making was collective.

Himmelman's (1993) continuum of working together, introduced in Chapter 3, is summarised at four levels: Networking *is exchanging* information for mutual benefit. Coordination *is exchanging* information *and altering* activities for mutual benefit and to achieve a common purpose. Cooperation *is exchanging* information, *altering* activities, *and sharing* resources, for mutual benefit, and to achieve a common purpose. Collaboration *is exchanging* information, *altering*

activities, *sharing* resources, *and enhancing* the capacity of another organization, for mutual benefit, and to achieve a common purpose. (Himmelman (1993). However, this study has taken further Himmelman's (1993) understanding of collaboration as *the process of co-creating knowledge while sharing physical or virtual space*.

EdNA was developed initially through collaboration among the stakeholders, then moved to cooperation when the States sought to engage more widely in the education technology agenda in 2000. The development of the directory service of resources, and search and browse functions continued the collaboration to develop EdNA that had been established by the Commonwealth. At this time the Advisory Groups for each sector became active and made significant contributions to the overall development and management of EdNA although, as noted previously, contributions were stronger from the school sector than from training or higher education. However, as the development of EdNA became more routine and as Education.au took on greater responsibility for consultation for the development of EdNA with the States and when the States looked to a wider national agenda for ICT, as noted in Chapter 7, then collaboration about EdNA moved to become cooperation in the year 2001 (exchanging information, altering activities and sharing resources) and later in 2002 coordination (exchanging information, altering activities) as defined by Himmelman (1993).

From 2002, the coordination mode of operation lead by Education.au became the norm for the development of EdNA. Education.au used national think tanks, consultation with the States, feedback on plans for the development of EdNA and an internal Education.au committee, the ERC, to make recommendations to the Board for passage to the Commonwealth for approval of funding. This complex process of coordination continued throughout the development of the new shared information services in 2004, EdNA Groups in 2005 and *me.edu.au* in 2008. However, with the advent of EdNA Groups, online collaboration for the further development and refinement of EdNA initiatives emerged as an important factor because it engaged such a wide audience. During the development of *me.edu.au* over 4,000 EdNA users made contributions or were engaged in providing feedback for the service (Black, 2008). The characteristics of collaboration were clearly evident in these online

processes especially shared leadership and competent technical contributions as well as shared goals, and shared processes for operating online and making decisions. The online collaborators operated within a clear framework to harness the collective intelligence and a range of diverse ideas through flexible and open communication.

The peak periods of EdNA usage were responses to organised promotions of EdNA, that were events utilising new EdNA features or were planned new releases of EdNA functionality or services. For example, the first peak usage period occurred in April 2002 in the lead up to the Global Summit later that year; the May 2003 peak was directly attributable to new technologies being launched such as sibling sites, collaborative workspaces and customised services; May 2004 was again a new technology in the provision of access to federated databases; then in June 2005 there was a new and improved search facility together with an EdNA usability improvement; May 2006 can be attributed to EdNA Groups usage; November 2006 to another Global Summit; August 2007 to more technical improvements for mobile phone access and personalisation services and March 2008 to the launch of a mature personalised service in *me.edu.au*.

Collaboration with stakeholders decreased as the processes moved towards coordination from 2001, whereas collaboration with users increased through the use of the social media (Web 2.0) type EdNA Groups facilities in 2005. What is noticeable is the degree of innovation that occurred throughout the coordination period whereas collaboration occurred among stakeholders when the issues were new, interesting, and posed common education challenges. Alternatively, online collaboration occurred among users when they were able to contribute to the development of the EdNA service. In fact, as was reported previously in Chapter 5, when the level of influence occurred at the national and Ministerial level then collaboration among stakeholders was strong. As one interviewee said, 'Without collaboration, nothing would have happened'. (Respondent E). However, when the level of influence moved to the level of the company, that is Education.au, then the processes for involvement in the development and management of EdNA moved through cooperation to coordination.

Interestingly, collaboration was not evident in the projects within the EdNA initiatives that did not proceed. As shown in the analysis reported in Chapter 7, the telecommunications project did not have a common purpose among the Commonwealth and States; the Higher Education Committee did not have a common agreed purpose; the training sector in developing the flexiblelearning.net.au service for the Australian Flexible Learning Framework did not have shared goals, processes or decision making with EdNA and the commercial materials initiative, although initiated collaboratively, when implemented did not have shared national goals and processes or mutual responsibility because the States wished to compete for commercial gain.

What can be noted from the above is that collaboration can operate at the most senior level or among online users when new and challenging issues that are predicted to have a wide impact on education are harnessed through strong leadership. For example, the initiation of EdNA was lead collaboratively among stakeholders by the Commonwealth but the innovation of EdNA's services, after 2005, was lead collaboratively among online users by Education.au. Collaboration was engaging but did require considerable time to take into account all of the necessary feedback, ideas and contributions. When collaboration became regularised then the mode of operation would appear to have moved to cooperation and then coordination as the project matured and the processes for consultation and decision making were known and agreed. Collaboration would appear to have been demanding and exhausting even though it did harness a diversity in expertise and thinking by engaging the States as stakeholders. In addition, collaboration did appear to create an expectation of a continued mode of operation or as a value of working together among participants. The Constitution of the national EdNA coordinating agency Education.au (Education.au, 1998a) provided strong evidence of collaboration as did Education.au's concentration on collaboration as a process (Education.au, 2004a). However, collaboration did not appear to be a mode of operation that could be sustained over long periods of time, as can be seen from the EdNA initiative, due to its demanding and exhaustive processes although the persistence of the value of collaboration may have been an advantage as new developments arose.

Implications for education

The fourth research question was:

What are the implications of these findings for educational policy, planning and good practice?

This question has been discussed below.

The chronological history of EdNA, its likelihood of success, its adoption by users and the collaboration that occurred have highlighted the confusion of the application of the terms collaboration, cooperation, coordination and networking (Himmelman (1993). Since EdNA was initiated in 1995, the term collaboration has been used to describe the process of working together when in fact, during EdNA's most innovative period, from 2002 to 2009, the development of EdNA operated by cooperation and, later, coordination led by Education.au. The national groups sought a wider than EdNA agenda in educational technology. The collaborative period was useful for the establishment of EdNA in 1995, even though EdNA was not launched until 1997, and lasted until 2000, a five year period.

Two issues for educational policy and planning arise from these findings. The first is that to establish a national educational initiative, especially an ICT innovation, then collaboration through strong, high level leadership can result in a greater likelihood of success. Secondly, the EdNA initiative included all three levels of education (schools, training and higher education) as well as the three sectors of schooling (State, Catholic and Independent). The inclusive nature of the EdNA collaboration with shared leadership, goals, decision making and communication, harnessing relevant skills, intelligence and thinking, led to a broad diffusion of EdNA throughout education. The fact that education users in schools dominated the usage statistics may be somewhat misleading because of the large size of the schooling sector. Training and higher education users were consistent users of the service although for different purposes. In Figure 8.1 below, a comparison of education sector use of EdNA Groups can be seen. Figure 8.1 shows clearly that the training sector (VET) had a larger number of users for EdNA Groups than the other sectors.

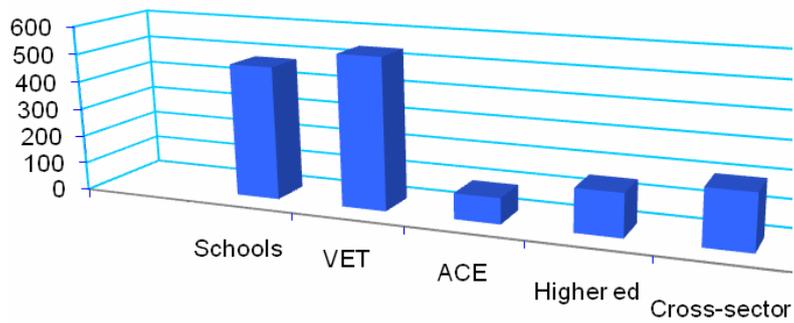


Figure 8.1: Groups numbers by sector as at December 2008

Source: Education.au, 2009c, p. 20

The cross sectoral nature of the EdNA initiative was important because of the wide diffusion of EdNA as well as the harnessing of diverse thinking and skills sets. Based on the reported findings of the establishment of EdNA, national ICT in education projects required cross-sectoral, inclusive collaboration with strong high level leadership and in the case of EdNA appeared to mature in five years. However, to suggest that collaboration be maintained for five years does not take into account the antecedents of the likelihood of success addressed in this research. In fact, this research reported that when the antecedents of EdNA were in place, by the year 2000, then the national collaborative groups such as AICTEC and the three sectoral advisory groups, sought a wider agenda in educational technology in education, although EdNA was the catalyst. The findings from this research indicated that national ICT in education projects that plan for the success of the attributes of innovation through collaboration, especially online collaboration, have a likelihood of being successful.

This research, consistent with the proposition that *the successful diffusion of an ICT innovation in education can be assessed by its antecedents, its rate of population take up and the strength of collaboration associated with its development and use*, has found that collaboration was valuable to establish the antecedents that became indicators of the success of the initiative. However, when the success indicators were established for EdNA, a large-scale national ICT in education initiative, then physical collaboration which was inclusive, demanding and resource intensive, had served its purpose.

When the collaboration moved to cooperation or coordination or networking, as classified by Himmelmann (1993) then there was a need for independent and trusted leadership and expertise to undertake development and management of the innovation. An interesting observation from the data consistent with the recall of interviewees, as well as the researcher, reported in this study, was that the most innovative period for the development of EdNA was when the initiative was being led by Education.au between 2002 and 2009. During that period EdNA introduced shared information services, group services and personalised services. More recently EdNA has coordinated other innovative services such as Open ID, single sign-on and management of digital identities, said one interviewee. (Respondent A). The period of innovation, as observed through the EdNA initiative, occurred through coordination by a national, neutral and trusted organisation in Education.au Limited.

This study has found that collaboration can be useful to establish a national initiative but innovation can be more successful when an initiative matures and is coordinated by a neutral and trusted body. This study also found that when collaboration among the stakeholders decreased then their engagement in the initiative also decreased and placed the venture at some risk.

Another observation reported from the data and information about EdNA was the importance of marketing the national service, so that users and potential users became aware of the service and its diversity. When examining the peak period of EdNA usage, the observation that peak usage periods corresponded to the promotion of events or releases of new technology or services for users was inescapable. EdNA as a national ICT in education initiative, improved its take up and diffusion through marketing activities when Education.au was leading and using coordination as the mode of operation. The very nature of ICT innovation in education is complex, observable only through a screen or projector and not always compatible with existing values. The implications of this are that constant marketing to education, demonstrations of the educational benefits of the technology and how technology can improve learning are essential for successful diffusion and take up.

After fourteen years of operation the statistics for the diffusion of EdNA, with 465 web pages, are impressive and are summarised below.

Resource database (*EdNA search and browse*)

- Total database items = 41,368, (39,694 resources, 871 events, 803 news items)
- Resource items accessible by distributed search = excess of 3 million digital resources

Memberships (*Shared Information Services*)

- 35,349 members have self-registered with any edna registered service via single sign on (i.e. Groups, Lists administration, me.edu.au or any combination)
- 23,205 edna Groups (Moodle) members
- 14729 me.edu.au members
- 123,928 edna List email subscribers

Groups (*EdNA Groups*)

- Groups member growth over 2 year period Jan 2007-December 2008 = 113%
- Growth in number of communities for same period = 100%
- Growth in single sign-on (i.e. all member services) for same period = 127%
- Growth in email List subscribers for same period = 65%.

(Education.au, 2009b, pp. 19-20)

The model that has been used to establish, develop and manage EdNA has been nationally successful for the diffusion of ICT in education. The cross sectoral nature of the EdNA collaboration enabled a broad range of expertise to be harnessed and engaged to benefit the initiative. However, the sustainability of EdNA to remain innovative when it moved to cooperation then coordination was increasingly supported by the online collaboration of its users. It was apparent from this analysis that restrictions and constraints to online collaboration among educators can seriously impede the take up of ICT in education innovation and likely other national initiatives.

At the time of writing and following the June, 2009, meeting of MCEECDYA (formerly MCEETYA) in Hobart, Australia, the Chief Executive Officers of both Curriculum Corporation and Education.au Limited announced that the Ministers of Education and Training had approved the organisational consolidation of both national companies to occur by June, 2010 (Education.au, 2009a). The MCEECDYA Secretariat publicly announced the formation of the new company to be called Education Services Australia (MCEECDYA, 2009b) late in 2009. The new company's role will be to, 'advance key nationally-agreed and commissioned initiatives, programs and projects in line with national initiatives ..'. EdNA was not mentioned in either of those announcements and so a reasonable assumption would be that EdNA's future was yet to be decided.

The diffusion of ICT in education nationally requires careful collaborative processes led from a high level of influence to plan for the successful achievement of the attributes of innovation of an initiative before moving to other modes of operation such as cooperation and coordination. Innovation would appear to become more apparent when the initiative is coordinated by an independent trusted body and online collaboration is harnessed. However, the risk to the initiative when coordination occurs among stakeholders is that the innovation-decision process needs to be carefully and creatively managed.

Further research

The emergence of online collaboration observed through EdNA Groups in 2005 and in *me.edu.au* from 2008, reported in this research, has been largely undocumented. Although the development of the services and the subsequent user feedback to further refine the services has been documented, there remains limited documentation and research into online collaboration and the benefits for education and learning. As one respondent suggested:

There were strong expectations that take up would be high but the exact ways that educators would collaborate, how they would take it (online collaboration) on board and use it in practice was probably unknown.

A broad review of the literature on collaboration by Millea and Galatis (Education.au, 2009d) indicated that online collaboration can benefit learning. However, the types and levels of interactions in the online communities of teachers engaged in professional learning are unknown. The performance of students undertaking learning programs using online collaboration and collaborative tools is also unknown. As collaboration was shown in this study to be a powerful process for the co-creation of knowledge, this study recommends further research into the beneficial uses of online collaboration in educational practice, in order to understand and utilise the take up and educational capacity of online collaboration to benefit teaching and learning.

Concluding comments

The implementation of large scale national ICT in education innovations is a complex process, especially when cross sectoral education interests are involved. As the Commonwealth increasingly engages in ICT innovations in education at the national level, with the cooperation of the States, there is a need to understand the processes and their indicators of success and the barriers to widespread take up. This research concludes that *the successful diffusion of an ICT innovation in education can be assessed by its antecedents, its rate of population take up and the strength of collaboration associated with its development and use.*

The study has found that the education profession does engage and respond to innovation when they are involved through collaboration. Therefore attention by education policy makers and planners to the attributes of innovation, to projected adoption rates, and to physical and online collaboration is essential for large scale national ICT in education innovation. The capacity to harness cross sectoral (schools, training, higher education) expertise and diverse perspectives would appear to further enhance the likelihood of success of an ICT innovation in education. There is a need for further research and analysis of the theory of ICT

innovation in education proposed in this research in order to improve implementation planning and to understand in greater detail how collaboration can be used to enhance it. From this research, online collaboration would appear to have become a powerful process for engaging participants in ICT innovations in education.

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Appendix 1: Summary of EdNA key events

Date	Key event	Responsible body	EdNA outcome
1980-1989	Computers in schools as stand alones	Individual schools with some education system support	Computers regarded as peripheral
1989	WWW	CERN	Graphic interface
1991-1996	Reports	C'wealth	National concern about harnessing communications technology for education
1993	OLTC	MCEETYA	First national effort to harness communications technology for education – brokerage and clearinghouse
1994	Networking Australia's Future: Final Report - recommendations for education and training	Dept of Communications, BSEG Report	DETYA considers possibilities for sharing resources
1995 (April)	Announcement of network	Minister Crean	AEN announced
1995 (May)	Agreement by States	MCEETYA	States to participate in EdNA
1995	Formation of DEETYA EdNA Taskforce	DEETYA	EdNA development begins

1995	OLTC to be expanded and restructured to govern EdNA	MCEETYA	Consultations with States about EdNA directions for development
1995	Network Business Requirements Reference Group (NBRRG)	MCEETYA	EdNA business requirements
1995	Reception Infrastructure Reference Committee	MCEETYA	Reception infrastructure panel contract
1996	ERC established from NBRRG	MCEETYA	Consultations with States about EdNA formalised
1997	OLTC restructured to manage EdNA	MCEETYA	National agency is refocussed
1997 (November)	EdNA launched	DEETYA	EdNA online service goes public
1997	EdNA Metadata Standard v 0.03 agreed	Commonwealth	
1997	DEETYA joins IMS	ERC, DEETYA	Adapt international standards
1998	OLTC becomes Education.au Limited	Company Board	New image
1998	EdNA hardware management transferred to Education.au	DEETYA and Education.au	Signed June, delivered August
1998	EdNA Metadata Standard v 1.0 approved	ERC	August. Adopted by sectors and Commonwealth

1998	OLTC becomes Education.au Limited	Company Board	New image
1998	EdNA hardware management transferred to Education.au	DEETYA and Education.au	Signed June, delivered August
2000	Introduced forums	Education.au Limited	Online communities diversify from Listservs
2001	States able to download and use EdNA applications	Education.au Limited	Embed EdNA in local services
2001	ERC changes to AICTEC	AICTEC	Broader strategic national role
2002	Education.au EdNA Reference Group formed	Education.au Limited Board	Representative consultation about EdNA's progress and annual plans for development.
2003	Federated search MyEdNA customised service	Education.au Limited	Access to large databases in real time Capacity for users to customise their usage
2003	Groups initiated from Forums	Education.au Limited	Web 2.0 based
2004	Shared Information Services introduced	Education.au Limited	Consolidation of news and distribution services with new services
2004	Groups trialled	Education.au Limited	Success

2005	EdNA Groups launched	Education.au Limited	Rapid take up and formation of online communities
2006	Personalised services initiated	Education.au Limited	Starts as 'My' EdNA with limited services
2008	Personalised services launched	Education.au Limited	Launched as 'me.edu.au'. Rapid take up and formation of online communities based on interests

Appendix 2: Interview background and questions

Interview

Background

I am focussed on the take up of EdNA and the role that collaboration had with EdNA's take up.

A theory has been proposed from the literature that:

The successful diffusion of ICT in education can be judged by its antecedents, its rate of population take up and the strength of its collaboration.

The attributes of innovation (Wilson, 2000; Rogers, 2003) have been used as the antecedents of EdNA to judge the likelihood of its take up. They are:

- Relative advantage
- Compatibility
- Complexity
- Trialability
- Observability
- Support, and
- Modification or reinvention

The take up of EdNA occurred in five distinct phases which were:

1. The initiation phase 1995 to 1997
2. A directory service of evaluated resources 1996 - 2009
3. Shared Information Services 1996 - 2004, 2005 -2009
4. Group collaborative services 2004 - 2009, and
5. Personalised services 2007 – 2009.

To test that theory, the definition of collaboration that has been used was:

Collaboration is the process of co-creating knowledge while sharing physical or virtual space.

The strength of collaboration was judged by the strength of its characteristics which were:

- *shared leadership*
- *common goals*
- *shared process and framework*
- *shared decision making*
- *mutual responsibility*
- *change resilience*
- *network intelligence*
- *flexibility and responsiveness*
- *open communication*
- *diversity in thinking, and*
- *appropriate level of technical competence.*

I wish to ask you about the take up of EdNA and collaboration in its development, growth and management. I have used the five phases of the development of EdNA within which to frame this interview.

I have eleven questions and I may wish to ask further questions of clarification, from you, as we proceed through the interview.

Let's begin the interview questions.

Interview questions

Let's start with the Initiation phase of EdNA 1995 to 1997

Q1: Did you expect EdNA to be successful in the Initiation phase (you may wish to refer to the attributes of innovation) ? Why/why not?

Q2: Was collaboration strong (you may wish to refer to the characteristics of collaboration)? Why/why not?

A directory service of evaluated resources 1996 – 2009

Q3: Did you expect the take up of EdNA to be successful in the Directory Service phase? Why/why not?

Q4: Was collaboration strong? Why/why not?

Shared Information Services 1996 - 2004, 2005 -2009

Q5: Did you expect the take up of EdNA to be successful in the Shared information Services phase? Why/why not?

Q6: Was collaboration strong? Why/why not?

Group collaborative services 2004 - 2009

Q7: Did you expect EdNA to be successful in the Group collaborative phase? Why/why not?

Q8: Was collaboration strong? Why/why not?

Personalised services 2007 – 2009

Q9: Did you expect EdNA to be successful in the Personalised Services phase? Why/why not?

Q10: Was collaboration strong? Why/why not?

Further comments

Q11; Do you have any further comments about the take up of EdNA and the role of collaboration?

Thank you for your time and your contribution

Gerry White

Appendix 3: Abbreviations

The following abbreviations and full names have been listed in order to assist the reader.

AICTEC	Australian ICT in Education Committee
DEET	Department of Employment, Education and Training
DEETYA	Department of Employment, Education, Training and Youth Affairs
DEEWR	Department of Employment, Education and Work Relations
DEST	Department of Education, Science and Training
DETYA	Department of Education, Training and Youth Affairs
EdNA	Education Network Australia
ERC	EdNA Reference Committee
EVAG	EdNA VET Advisory Group
FLAG	Flexible Learning Advisory Group
HEAG	Higher Education Advisory Group
ICT	Information and Communication Technology
MCEECDYA	Ministerial Council of Employment, Education, Child Development and Youth Affairs
MCEETYA	Ministerial Council of Employment, Education, Training and Youth Affairs
NBRRG	(EdNA) Network Business Requirements Reference Group
OECD	Organisation for Economic Co-operation and Development
OLTC	Open Learning Technology Corporation
VET	Vocational Education and Training
WWW	World Wide Web

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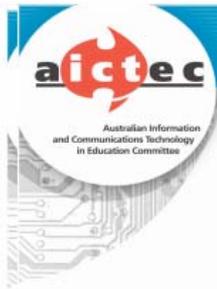
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Position: CEO

Date: 18/3/08

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AICTEC



Australian Information and Communications
Technology in Education Committee (AICTEC)

AICTEC Secretariat
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University of Canberra
CANBERRA ACT 2600

Phone: (02) 62012983
Fax: (02) 62012549
<http://www.aictec.edu.au>

Mr Gerry White
gerrywhite@internode.on.net

Dear Mr White,

I write regarding your request to access selected Australian Information and Communications Technology in Education Committee (AICTEC) documents to support you in the development of your PhD thesis as per your email dated 24 October 2008.

I am pleased to advise that at its' meeting of 28 October 2008, AICTEC agreed to provide you with access to the AICTEC meeting minutes which can be accessed through the AICTEC website. The AICTEC meeting minutes are available online from 2002 to 2008.

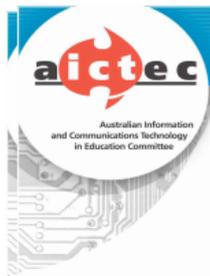
Ms Sue Hollands, AICTEC Executive Officer, will contact you with information regarding confidential access to the appropriate part of the AICTEC website. It is requested that you complete the attached 'Code of Conduct' form AICTEC members are asked to also complete, and that you return it to the AICTEC Secretariat office.

AICTEC wishes you well with your research and looks forward to the significant insights that will undoubtedly result from your work.

Yours sincerely,

for.
Evan Arthur
Chair
Australian Information and Communications Technology in Education Committee

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14 November 2008