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Telematics in rural education : an investigation of the use of telematics for the delivery of specialist programmes for students in rural schools

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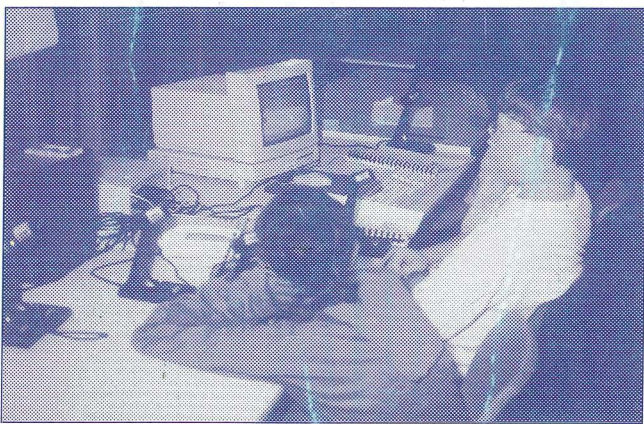
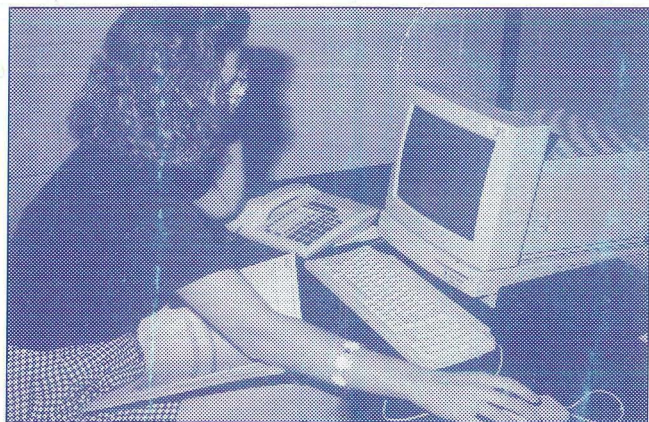
EDITH COWAN
UNIVERSITY

PERTH WESTERN AUSTRALIA

TELEMATICS IN RURAL EDUCATION

AN INVESTIGATION OF THE USE OF TELEMATICS FOR THE DELIVERY
OF SPECIALIST PROGRAMMES FOR STUDENTS IN RURAL SCHOOLS

RON OLIVER & TOM REEVES



TELEMATICS IN RURAL EDUCATION

**An investigation of the use of Telematics
for the delivery of specialist programmes
for students in rural schools**

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1.0 INTRODUCTION

Rural Education

Rural students face many problems that do not necessarily confront their city counterparts. Education is a process that carries strong economies of scale. It is economical in instances where resources and facilities can be shared. It is very much resource based and much of the quality of educational programmes is derived from the resources and facilities that support the teaching/learning programme. This type of scenario makes it possible for a strong distinction to emerge in the quality of the educational programmes received by rural and metropolitan students.

The worst case scenario shows stark comparisons. Rural students spend more time getting to school than metropolitan students and when they are at school, they are in many cases, serviced by teachers with less teaching experience. Rural teachers have access to minimal teaching resources, are less likely to interact with teaching colleagues from other schools and have less exposure to professional development opportunities. Rural teachers are often compelled to teach outside their subject-disciplines and to deliver lessons to heterogeneous groups with widely varying needs and wants.

Whereas in metropolitan schools, parent bodies contribute significantly to the provision of extra resources, materials and equipment, the parent contribution is likely to be less in the country school. The small size of the rural schools and the often low socio-economic profile of the communities all contribute to a diminished level of outside support in these schools.

Problems facing Rural Students

Comparisons of the educational outcomes from rural and city schools are starting to show worrying trends. It is evident in Western Australia that;

- rural students have reduced options in terms of the subjects that they can choose to study,
- facilities for post-compulsory education are less convenient and are less available,
- the achievement of rural students in tertiary entrance examinations is considerably lower than their city counterparts.

For many years now, all Australian states have serviced a distance education unit within their education systems to provide for the distinct educational needs of students in remote areas. Much of the effort that has gone into the provision of quality distance education programmes has had little impact on the plight of the teachers and students in rural schools.

Recent initiatives in Australian education have seen plans drawn up to increase the participation level in post-compulsory education. The plans have established the goal of having at least 95% of all Australian children staying on to complete a post-compulsory component in their education. While this is a very achievable aim within the metropolitan areas of

Australia, it poses very large difficulties for rural Australia where post-compulsory opportunities for school children are severely restricted.

The restrictions facing Western Australian rural schools in the provision of post-compulsory education was the key factor that drove teachers and administrators in the local setting, to establish the project that is the focus of the research that is described in this paper; Stage 1 of the National Element Priority Country Area Programme project, the PCAP project.

PCAP Project

The PCAP project was a project funded by the Commonwealth of Australia. The project involved four clusters of schools in rural areas of Western Australia, organising and delivering educational programmes among themselves using Telematics technology. Use of the Telematics technology provided a means for the participating schools to offer a broadened curriculum. The curricula that were chosen by the schools were those that were judged as being able to contribute significantly to the students' post-compulsory schooling programmes.

The research that is reported in this paper was undertaken as part of a commissioned study to provide an evaluation of the PCAP project. The study was required to assess aspects of the administration of the project and its capacity to achieve its intended goals. The project made extensive use of new and innovative form of telecommunications technology called Telematics.

This Research

In carrying out the commissioned research, the researchers took the opportunity to more fully investigate the use of Telematics in rural schools. This technology is finding growing use in other Australian states and territories. It appears to have the potential to overcome many of the problems facing the delivery of specialist programmes in rural schools. This paper reports on a broad study that sought to investigate ways and means to fully utilise the potential of Telematics. As well as evaluating the PCAP project, the study examined factors influencing the uptake and effectiveness of Telematics teaching and learning in rural schools. The aim of the project was to gather information to enable the technology to provide maximum advantage to an often disadvantaged component of Australian schooling, rural education.

1.1 TELEMATICS

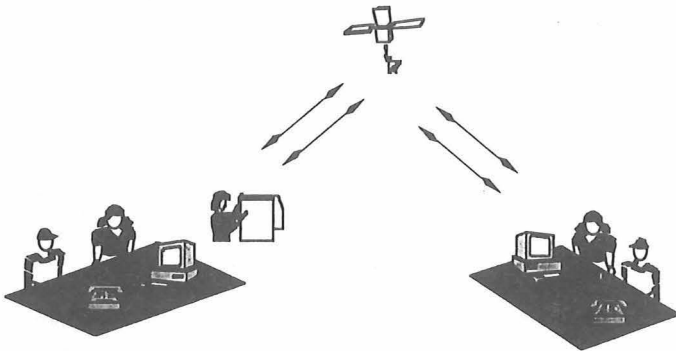
The term, Telematics is used in broad contexts within education systems to describe teaching and learning environments that employ real-time telecommunications to provide interactivity between teacher and student. Increasingly, Telematics systems are being used in the delivery of distance education programmes. The flexibility and versatility of such systems enable them to be used in a variety of forms, seeking wide learning outcomes and overcoming traditional problems in the delivery of distance education.

Teachers using Telematics operate in a virtual classroom that extends the boundaries of a normal classroom to include students in remote schools. Communication between the teacher and the remote students is achieved by three forms of technology.

- a. **telephone**; an audioconferencing telephone link using hands free telephone systems provides the capacity for interactive voice contact between teacher and students.
- b. **facsimile**; the facsimile technology enables instructional materials and student scripts to be transferred between the teacher and students in real-time.
- c. **computer**; computer communications provides the classroom with an interactive blackboard that can be viewed and used by all class members.

Figure 1.1 Telematics Teaching

The teacher communicates with students at remote sites using a variety of telecommunications devices to provide an audio, visual and document link.



These three forms of technology respectively provide an audio, a document and a visual link within the extended classroom and create a distance education learning environment that closely models face-to-face teaching. The only missing element being the face-to-face visual link.

Telematics teaching does not require all three elements to be operating simultaneously. The critical and essential element is the voice link, while the fax and computer link provide an enhancement to the learning environment.

Telematics in Distance Education

The use of telecommunications has long been recognised as a valuable tool in the delivery of distance education. For as long as fifty years, such agencies as the school of the air, have been using telecommunications to combat the loneliness and independence of the distance education student. The provision of an audio link combined with access to consistent instructional materials has provided an effective means for a remote teacher to simultaneously teach students in remote locations.

Modern technology has seen the proliferation of telephone links and there have been a number of teaching-learning environments established using the model of the school of the air with telephone in place of radio communication. Distance education agencies have been able to use telephone systems to create audio-links for subjects where the voice link is critical to learning, for example language learning. When one observes a distance education classroom where the voice link is being used, as well as the feedback that is gained by both the student and teacher, one observes the extra human dimension in the teaching that serves to enrich the environment considerably.

Early versions of Telematics teaching extended the telephone voice-link to include facsimile connections. These two technologies enabled both voice and document interactivity and proved to be a very effective combination for the delivery of distance education. Not only could teachers chat and talk with distant students, they could deliver instructional materials at the point of teaching and review student activities as well.

The logical extension to the phone-fax system was the inclusion of computer technology to provide a visual link of some form in the teaching and learning. In Australia, the computer link was made possible by the development of Electronic Classroom, a computer based software application enabling up to 6 remote computers to be connected. Once connected, the software provides the facility to transfer data from a host machine to others in the system. The screen image on all systems is kept consistent and there is a facility for any of the machines in the system to be used to vary the screen image and to have the changed image appear across all machines. The computer link in the Telematics classroom provides an electronic blackboard. The teacher is able to prepare blackboard images prior to a lesson and to transfer these images during the lesson as part of the teaching process.

Telematics in Australian Schools

Whereas distance education has traditionally been concerned with the delivery of an educational programme to individual students in remote

locations, these methodologies are now being used more and more for the provision of educational programmes in school settings as well. The methodologies are able to provide specialist courses to students for whom the conventional school programme is not well suited. Issues of social justice and equity have prompted moves to apply new technologies to providing educational programmes to students with special needs. Telematics has proved to be a technology with particular advantages in this area.

Telematics teaching in Australian schools can be traced back to the mid 1980's when Victorian teachers in the Loddon-Campaspe Region used the technology as a means to sustain broader curriculum offerings for post-compulsory students in schools in this country region (Evans and Nation, 1992). An important feature of the early Telematics programmes was the regional nature of the project. Clusters of schools with particular curriculum needs were able to combine together to create immediate solutions. The programmes required only modest amounts of funding to proceed because they tended to make use of existing facilities and programmes applied in innovative settings.

In essence, the project revolved around smaller country schools sharing teaching resources to increase curriculum offerings among the schools. A teacher at School A would teach a small class and use the technology to simultaneously teach students in classes at other schools, for example School B and School C. The collaborative nature of the project saw a teacher or teachers at Schools B & C returning teaching in other subject areas to students in School A. The nature of the teaching and programme delivery necessitated planning and cooperation among schools in associated clusters. The overwhelming success of the initial cluster of schools in Victoria prompted other regions with similar needs to follow suit and many other clusters were formed.

Telematics programmes have been set up in other Australian states and in many cases, these programmes have followed the lead of Victoria. Similar needs in the other states have often resulted in similar programmes and much of the Victorian development in this area has been applied directly in the programmes of other Australian states.

The Technology

Audio Links. The original Telematics lessons in Victoria made use of audio and document links alone. The audio links were made through the DUCT system (Diverse Use of Communication Technology). The DUCT system includes a terminal with a number of "push-to-talk" microphones and a loudspeaker. Students must hold a microphone to speak and the push-button is used to prevent many students speaking at once through the system. The loudspeaker broadcasts the voice coming down the line. Improvements in communications technology have seen the emergence of less-costly hands-free telephones and specialised audioconferencing devices.

Audioconferencing requires special communications to link multiple callers. While this was once only able to be done through Telecom operators, users can now purchase an audioconferencing bridge to create their own conferences. This system provides several advantages over booked conferences. The connections can be completed more quickly and there is flexibility in the choice of participants on a day-to-day basis.

Document Links. The fax machines that are available today have increased significantly in performance and power while decreasing significantly in cost. Today's machines have automatic diallers and can broadcast fax messages to multiple sites. The machines are simple to use and require little training or expertise to operate.

Visual Links. There have been many applications developed that have had the potential to provide the visual link in Telematics teaching. Such devices as electronic whiteboards, full colour television and sound, electronic blackboard with Voice-to-modems have been trialed and tested within the Victorian Education system. By 1989, most sites were using Macintosh computer systems and modem connections with software that linked the computers' processing units so that each performed the same operations.

A local software application, Electronic Classroom was developed in 1990 to overcome the shortcomings of the existing systems and to provide a customised application for Telematics teaching. Electronic Classroom was designed to provide an interactive electronic blackboard able to be used across multiple sites with features that supported this application of teaching and learning. In much the same way as teachers use conventional blackboards, this application can be used to draw images, to paste pictures, to create text while providing a flexible means of interactivity. The blackboard can be operated through a variety of interfaces including, keyboard, mouse and graphics tablet.

Since there can be many students observing the blackboard in any lesson, it is necessary to have some means to broadcast the screen image. Victorian schools have trialed large monitors and overhead projection panels for this purpose. Although more expensive than the monitors, the overhead projection panels create a large and useable image and have become the preferred medium. Problems with poor image brightness due to ambient lighting remains a problem to be overcome.

Telematics Teaching in the Classroom

There are now in excess of 500 sites in Australia which have the technology to participate in Telematics teaching and learning using Electronic Classroom. The same equipment that is used to deliver a Telematics lesson can be used to receive. In most instances, where a school or site is used extensively for delivering lessons, enhanced

hardware is employed to enable multipointing, the simultaneous delivery to multiple sites.

Delivery System. The minimal delivery system for Telematics delivery is a system comprised of a Macintosh computer with Electronic Classroom software, a modem and a hands-free telephone system. It is possible to use an existing fax machine in the system with materials being sent and received before and after lessons. Two special-purpose telephone lines are required for the computer and audio connection.

For multipointing and audioconferencing capabilities, delivery sites can also require an enhanced computer system able to support multiple modems with an audioconferencing bridge.

Receival System. The minimal delivery system for Telematics receival is a classroom setting comprised of a Macintosh computer with Electronic Classroom software, a modem and a hands-free telephone system. Once again, it is possible to use an existing fax machine rather than needing to have one specifically assigned to the Telematics classroom.

This teaching mode relies heavily on technology for its success. As well as hardware and software, the application demands trained personnel. The skills and expertise in teaching with Telematics, require a high degree of familiarity with computer hardware and software. Teaching with Telematics requires an experienced subject teacher with a degree of technical computing skill.

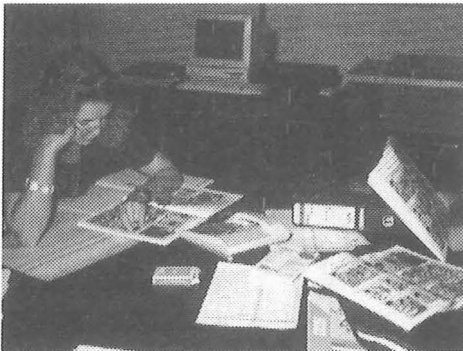


Figure 1.2
A lesson being delivered. The teacher is speaking through a hands-free telephone to students. The computer is currently not being used. This class has both external and internal students. Two internal students can also be seen in this picture.

A typical lesson commences with an audio link being made between the teacher and students. If more than one external site is involved, the telephone connection becomes an audioconferencing connection. This is achieved by booking through Telecom and at the specified time, Telecom dials each of the parties and establishes the connection. The audio link is the most important component in the lesson. To create the computer link,

the students dial from the remote sites using modems and create the computer connections to the teacher's machine.

A typical lesson sees the audio link being made and the teacher greeting each student to determine who is present for the lesson. There is a high degree of dialogue and teacher direction in a Telematics lesson as the teacher tries to involve all students. Teaching is carried out by having the computer act as an interactive blackboard. The teacher prepares screen images before the lesson and transmits these to each computer at the link stage. Under the control of the teacher, an image is made to appear on all computer screens. For example, a mathematics problem. The teacher can add to the image and these additions show immediately on every screen. For example, the teacher can commence to work the mathematical problem. The control can then be passed to an external computer and the student(s) at that site can add to the image. Interaction is through the mouse and a tool palette and the keyboard. The additions show immediately on every screen. By passing control back and forth among students and teacher, the lesson is able to progress in a similar fashion to face-to-face teaching.

Telematics classrooms are necessarily smaller than conventional classrooms. The optimum size for a class depends on such factors as the subject being studied and the number of remote sites involved. It is difficult to seat many students around the computer screen and provide access to the peripherals. Many schools use an overhead projection panel to make the screen image more visible. Due to the nature of the teaching, it is difficult to cater for individual differences when large ranges exist in ability among the students. The participating students need an element of self-motivation and need to be responsible for much of their own learning. There are many differences to teaching and learning with Telematics compared to conventional classroom instruction.



Figure 1.3
Students receiving instruction. The students have a hands-free telephone in the middle of the desk and pass the mouse and keyboard between themselves to interact with the computer.

Classroom Configurations

There are a number of ways in which the equipment use and class application can be configured. The forms of configuration depend on the students being taught and the subject being delivered. A common configuration is to have a delivery teacher connected to one site with a number of students in the class. Frequently, there are a number of remote sites connected to a delivery teacher and through telephone conferencing, the students can hear and speak to each other as they might in a normal classroom.

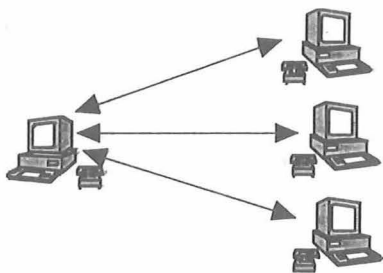


Figure 1.4
Telematics can link one teacher with many students at a number of remote sites.

In some settings, it is expedient for a teacher to have students in a face-to-face mode as well as having external students. Once again, the students can communicate with each other and the teacher. The only shortcoming being that the external students can not be seen.

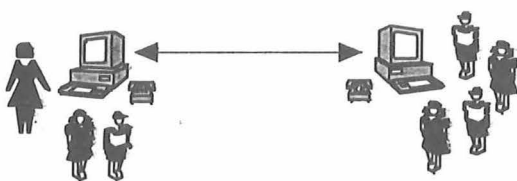


Figure 1.5
Telematics can involve face-to-face teaching as well as students at a number of remote sites.

There is no limit to the distance over which Telematics teaching can take place. With Telematics programmes, it would be possible for schools in other systems, sectors and states combining in the teaching and learning process.

Teaching

Preparation for a lesson can take longer than the time taken to deliver the lesson. Screens for the computer program have to be created as have instructional materials for the students. The instructional materials are usually sent by fax to the remote students for distribution to the students before a lesson.

Because the teaching and learning are in an external mode, the Telematics teacher must prepare instructional materials that can be used independently by the students. Typically, the teacher will prepare booklets and sets of curriculum materials to be used by the students for independent activity outside lessons.

Telematics teaching requires a support person at the receival school to administer the students. The support person is needed to liaise with the delivery teacher, ensure students are ready for lessons, aid with technical problems, supervise the class during lessons and ensure that assigned tasks are completed and passed back to the delivery teacher.

Applications

Subjects that are particularly well suited to Telematics teaching include Languages, English Studies, Mathematics and the Social Sciences. These subjects involve a degree of communication and independent work and do not require the development of skills necessitating face-to-face teaching and learning. In some subjects with strong practical elements, Telematics can be used in support but would not normally be able to deliver the complete programme.

1.2 THE PCAP PROJECT

In 1991, the Federal Government made \$10 million available nationally for the 1992-1994 triennium to improve education and retention rates for rural students. Western Australia was given funding for a project to trial a selection of technologies in remote educational settings to determine the relative effectiveness of each in overcoming the disadvantage of isolation.

The national project was named *Using Alternate Delivery Systems to Increase Remote Student Access to Education*.

Project Aims

The stated aims of the project were to:

- increase the number of students in prescribed country areas completing a least twelve years of schooling,
- expand opportunities available to these rural school leavers,
- improve levels of student achievement,
- reduce incidence of gender bias in subject choice (particularly among students from low socio-economic backgrounds),
- increase opportunities for personal development through increased interaction with peers from broader cultural and socio-economic backgrounds.

Project Implementation

After initial notification of funding from the Department of Employment and Training (DEET) in August 1992, a Steering Committee was formed with representatives of the Western Australian Ministry of Education, the Catholic Education Office and the Northern Territory Department of Education. A WA State Working Party was also formed comprised of Ministry representatives from the Telecommunications Unit, Post-Compulsory Education, the Priority Country Areas Programme, the Catholic Education Office and a community representative.

The Steering Committee established overall policy for the project and met several times during the last half of 1992 to discuss the parameters of the project and possible collaborative ventures. The Working Party planned the specifics of the project and determined an action plan for the Country Areas Program National Element. It was planned to devolve funds through a submission process. The priorities, principles and criteria for projects were established and timelines set to ensure progress would be swift.

The PCAP field officers from the WA regions attended a 2 day induction course in Perth during which time they were exposed to various forms on new technologies that could be used to support alternative and flexible delivery. The induction course was practically based and provided the

officers with hands-on experiences. The technologies that were showed included Telematics, Interactive Television and Westlink.

PCAP field officers returned to their districts and organised schools to consider the possibility of adopting new technologies to improve equity and access for remote students. Information about the project was sent to all PCAP schools with secondary student enrolments inviting them to submit proposals to access funding from the CAP National Element through their area PCAP officer.

The PCAP officers arranged meetings with the principals of the schools in their areas to build support for the project and to cause principals to consider their needs in this area. Schools examined their curricula and considered ways in which equity could be improved. After a number of meetings between school principals, proposals for projects were drawn up in each of the PCAP areas in Western Australia. Nine proposals were submitted to the State Working Party for consideration with a total funding request for \$500,000 .

Assessment Procedures

Projects were reviewed by members of the Working Party. A numerical rating was allocated by each reviewer and the means of the scores of the reviewers was used to rank each of the proposals.

The criteria that were used were judgements of the extent to which projects:

- provided advantage over existing school systems (/10)
- could lead to increase in year 11/12 retention (/10)
- degree of increased accessibility (/10)
- curriculum relevance (/10)
- relevance of chosen technology (/5)
- degree of innovation (/5)

The criteria were chosen to reflect the aims of the project and to provide the means to allocate funds in a manner that maximised the returns and outcomes. Proposals were considered against these criteria and given a nominal score out of a total of fifty points based on the relative weightings given to each criteria. This score enabled the proposals to be ranked and the superior proposals were then funded.

Successful Applicants

Of the seven submissions, 4 received funding to conduct the projects that had been planned. The successful proposals were from the Kimberley, Geraldton, Pilbara and Kalgoorlie districts. The table overleaf shows the schools involved in the regions and the planned curricula to be implemented.

The successful projects all involved the use of Telematics. Telematics is a new technology and its implementation necessarily demands new

equipment and training for those supporting and using it in the schools. A considerable portion of each budget was given to the purchase of the necessary equipment and hardware and training programmes.

Table 1. 1
Schools Participating in Stage One CAP National Element

Schools	Curriculum	Technology
Kimberley District Broome HS Halls Creek DHS Sacred Heart College Nulungu College La Grange RCS Looma RCS	Applied Computing English for ESL students	Telematics
Geraldton District Meekatharra DHS Carnamah DHS Mt Magnet DHS Jurien DHS CBC Tardun	Maths, English, Social Studies Unit Curriculum	Telematics
Pilbara District Karratha SHS Exmouth DHS Newman SHS Paraburdoo DHS Tom Price HS Wickham DHS	Languages other than English Japanese	Telematics
Kalgoorlie District Leinster DHS Leonora DHS Laverton DHS Blackstone RCS Warburton RCS Wiluna RCS Menzies RCS Warakurna RCS Yintarri RCS	Education support - language students at risk, English Transition Mathematics	Telematics

Within the WA Ministry of Education, the Telecommunications Support Unit exists to provide a coordination and management service to schools using or seeking to use Telematics. This central branch provided the project with the capacity to effect a number of economies in training and project management. With all groups electing to use Telematics as the

delivery medium for the planned curricula, it was decided to organise the purchase of equipment and to supply the training components of the projects from a central position. The role of Project Coordinator was undertaken by a staff member from the Social Justice Branch of the WA Ministry of Education. Technical expertise and training support for the project was provided by staff from the Telecommunications Support Unit.

Project Administration

The initial stages of the project involved the ordering of equipment and software, adding telephone links to the schools to support the Telematics communications and training of the staff. Equipment purchasing was undertaken by the Telecommunications Support Unit, while the project coordinator planned and organised an intensive round of training workshops for teachers from the participating schools. Training was conducted in each of the regional centres. The purpose of the training was to provide several staff within each school with the skills and expertise required to independently support the use of this technology.

Table 1.2

Training Programme for Schools Participating in Stage One CAP National Element

Town	Content	Date
Geraldton Karratha Broome Kalgoorlie Darwin	Introduction to the Macintosh, Telecommunications, Electronic Classroom, Supporting Telematics teaching, Project overview	November 1992
Perth	Instructional design, Teaching with Telematics, Teaching strategies, Curriculum modifications	November 1992
Perth	Instructional design, graphical design, applications packages, Electronic Classroom Version 2.0	September 1993

Training and Preparation

The training workshops were conducted in a fashion that enabled the specific skills and expertise required by all participating teachers and administrators to be gained through practical experience. Teachers from the WA Ministry of Education Distance Education Centre and the Northern Territory Department of Education were also participants at the courses. The training was conducted by staff from the

Telecommunications Support Unit, Telematics personnel from the Victorian Education Department and the creator of the software program Electronic Classroom.

By the end of December 1992, all possible preparations had been completed. The staff were trained and equipment had been delivered to schools. The only hitches to a very smooth operation came from the inability of Telecom to install the required telephone lines into all the participating schools. Some schools in the remote areas were still waiting for connections to be made. The majority of schools had received their extra phone lines and had completed some trials among themselves to test the equipment and software in readiness for the commencement of the project at the start of the 1993 school year.

Training programmes continued to be offered throughout 1993 to further develop the skills of the delivery and support teachers. In some instances, the training was used to induct new teachers in schools where Telematics teachers were no longer based.

1.3 THIS RESEARCH

This research project was undertaken over a period of 3 months at the end of the first year in which the project had run. The purpose of this research project was to evaluate outcomes of the PCAP project which established Telematics technologies in the remote schools. In doing this the project was also able to focus on broader issues relating to the use of Telematics in rural education.

In particular, this research aimed to investigate:

- factors influencing the effectiveness of Telematics as a teaching and learning tool,
- the management and coordination strategies required to support an effective Telematics project in rural schools,
- the skills and competencies required by successful Telematics teachers.

This information has direct relevance to all stakeholders in the provision of rural education. By passing this information on to Ministry personnel, school administrators, school teachers and teacher trainers, it is hoped that the educational programmes offered to students in rural schools might be improved.

2.0 REVIEW OF THE LITERATURE

Educational Technologies

The application of technology in educational settings has been continuing at a rapid pace and has been as frequent as developments have allowed. There are many places where technology have been able to help the teacher and the learner. Such applications as radio and television in early years had moved to applications of computer technology in later years. One recurring outcome of the applications of technology in education is that in the long-run, very few applications have ever been able to live fully up to the original expectations. Even when research has validated their use, the educational significance of most applications has not produced the expected advantage (Cuban, 1986).

The reasons for the apparent failure of many technologies, lies not with the technology itself, but how it has been used. In many instances, applications of new technologies in education have focused on the technologies themselves rather than the message that they have been delivering. It is common for research to find more variance within media applications than between them (Stubbs and Burnham, 1990). Research continually shows that how a medium is used is more important than the medium itself. There is a need for teaching to focus more on the learning and the instructional arrangements than on the vehicle by which they are delivered (Riel, 1992).

Dunnett (1990) describes what he calls the "media-trap" where the teacher, or students, pays more attention to the media system than the instruction itself. Technology has a real capacity to distract the user. To illustrate this point, Heppell (1994) uses the example of the content of teacher inservicing in the use of educational technologies. The bulk of the instruction is given to operating the technology and making it work. Only minimal instruction is ever given to implementation issues and teaching strategies.

The problem of the technology leading the educational application is constantly with us and it is never likely to go away. As we move through the current era of interactive multimedia, teachers of all disciplines are being bombarded with applications and activities to solve all their instructional problems. The computer has become the solution, but many teachers are still pondering what the problem is or ever was.

Telematics

There are still however some real problems in education that technology has the prospect of solving. One of these problems is the delivery of specialist educational programmes to rural students. Specialist subjects are usually difficult to deliver to students in rural schools because there are usually only small numbers of students at such schools often being serviced by inexperienced teachers whose teaching areas are limited. The

problem is to find a cost-effective way to deliver the required programmes.

The development of Telematics technology in recent years has considerably increased the educational prospects of such students in rural schools. This technology provides the means to deliver interactive instructional programmes across a number of remote and physically isolated sites. It appears to be an ideal medium for the delivery of the specialist programmes required. Although this technology can provide this service, it remains to be seen whether the application will achieve its full potential and provide a real solution to a pressing and serious problem.

Distance Education

The application of Telematics among rural schools is a form of distance education whose potential and success is able to be judged and determined by the indicators that have been developed for this field. Distance education is the term applied to teaching and learning when the teacher and students for some reason are physically separated (Holmberg, 1989). Traditionally distance education has been seen as a very poor second in terms of the quality of teaching learning when compared to face-to-face teaching. More recently, however, the use of such technologies in programme delivery as Telematics, has led some to argue that not only can distance education match conventional teaching, in many instances, it can be better (Holmberg, 1989).

Interactivity and Independence

Traditionally, the two attributes of face-to-face teaching that are absent from distance education are interactivity and independence (Juler, 1990). All classroom teaching and learning is based on a degree of interactivity between teacher and student. The teacher plays a pivotal role in not only providing instruction, but also in motivating, leading and guiding students. At the same time, schools provide an organised and rigid framework for the learning programme. While schools can therefore be characterised by high levels of interaction and low levels of learner independence, in differing forms of distance education, interactivity and independence tend to be traded off each against the other. Garrison (1985) uses the following diagram to compare and contrast these entities.

In many distance education modes and open learning settings, high levels of both interactivity and independence are sought after (Haughey, 1991). These can be achieved by example, through the use of pre-prepared learning materials using alternative forms of learner interaction, including computer based learning materials. For the provision of specialist distance education programmes in a school setting, the preferred blend would appear to involve a high level of interactivity with lower levels of independence. This blend is a close match to traditional classroom

teaching and is evident in such delivery systems as interactive television and telelearning courses.

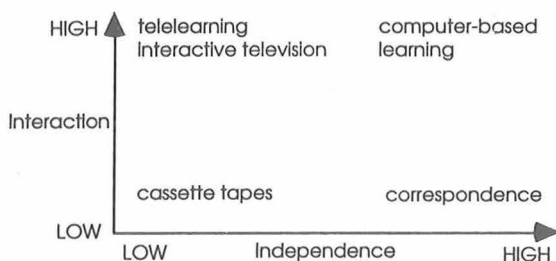


Figure 2.1

Interactivity and Independence across distance education delivery methods.

Although frequently mooted as a viable alternative, the use of computer based learning materials does not seem a viable alternative for delivery of specialist programmes in rural school settings. Apart from the high costs to create the required materials and the large demands placed on high-level computing resources in the schools, the mode still demands high levels of learner independence.

Telelearning and interactive television have the required attributes for the required instructional forms and have been used very successfully in similar settings elsewhere. The essence of these two modes of delivery is the establishment of a communications link between learner and instructor or between learners. The nature and scope of the learning that can be achieved is dependent on the mode of communication and instructional format (Riel, 1992).

Technology Generations

Nipper (1989) describes three technological generations in distance education; correspondence, multimedia and telelearning. When one thinks of traditional distance education formats, correspondence education readily springs to mind. In fact, many students in rural schools have been compelled to complete studies in specialist areas in this mode. In correspondence mode, the students use self-paced instructional materials under the guidance of an external tutor to whom assignments are sent and with whom limited interactions are made using telephone, fax and mail services. The student learns by following the procedures and activities set down in the instructional materials.

There are two main differences between learning by correspondence and learning in a classroom. The first is the difference in interactivity. The student and the teacher have limited opportunities for interaction and most of the learning is achieved by the student working independently on

pre-prepared materials and activities. The lack of interactivity is seen by many as the principal problem needing to be faced (Garrison, 1990). The second difference stems from the level of independence assumed by the learner. In correspondence mode, the learner is free to study when and where he or she elects. Correspondence education within a school setting is not a preferred form of instruction for students. They miss the interactivity of the face-to-face teaching/learning environment and many do not have the personal qualities required for independent study (Catchpole, 1993). If we need and cannot have a range of specialist teachers in a school, what is the next best solution that is reasonable and achievable?

The multimedia applications described by Nipper's second generation also have limited potential for school based distance education programmes. Although encompassing more effective and stimulating learning materials, there is the same problem of low interactivity with the teacher and a demand for independent learners. The telelearning generation involves delivery platforms that have the capacity to increase interactivity between teacher and learner while reducing the requirement for independent learning styles.

Telelearning

This technology refers to the use of telecommunications and computer mediated communications to create links between teachers and students. Goldman & Newman (1992) describe the use of various forms of communications technology and the learning advantages that result. These technologies include such applications as e-mail, audioconferencing and teleconferencing. These learning environments are characterised by active learning situations with student-initiated discourse using interactive communications. Research into the use of telecommunications and in particular, computer-mediated communications, frequently realise significant learning outcomes although these are principally reported as being within the affective rather than cognitive domain (Levin et al, 1992).

Telematics is a form of telelearning whose application seems ideally suited to delivering specialist programmes into rural schools. Its form is an extension of audioconferencing, a powerful and popular delivery mode of the past twenty years. Audioconferencing provides an auditory link between the teacher and students by which information can be shared, critically analysed and applied in order to become knowledge in the mind of the learner. Audioconferencing is a cheap and effective delivery mode with proven advantages derived from the interaction that it enforces and supports (Garrison, 1990). Telematics or audiographics as it is commonly called, adds a visual link to strengthen and improve the quality of the audioconferencing interaction.

Effectiveness of Telematics

There are a number of strategies that have been created as a means to judge the potential of telelearning courses that can be applied against Telematics to its robustness and integrity as an alternative delivery platform (Stubbs & Burnham, 1990; Collis, 1993). The models that are suggested by these authors differ in the context in which they are applied. Collis (1993) describes a strategy that reviews particular applications while Stubbs and Burnham (1990) describe a means to assess the technological dimensions of the application itself. When the criteria described by these strategies are applied to Telematics, few weaknesses appear to exist.

Collis (1993) suggests a 4 stage evaluation model that includes an

- an examination of intentions,
- assessment of local contingencies,
- observation of actual and contextual implementation and
- determination of incongruities between intended and actual outcomes.

Previous studies of the instructional effectiveness of Telematics provide very high ratings for implementations in rural schools against these criteria (Moore & Thompson, 1990; States, 1992; Evans and Nations, 1992). In examinations of classroom implementations, researchers have found a strong congruence between intended and actual outcomes with high correlations against the intentions of programmes. These outcomes tend to be consistent across applications and are achieved in differing formats and contexts.

Stubbs and Burnham (1990) describe the Potential Effectiveness Inventory (PEI) as a model that can be applied against electronic distance education systems encompassing telecommunications in the delivery platform. Five criteria are suggested;

- variety of communication paths,
- ease of use,
- realism,
- time and place independence,
- speed of communication.

Telematics fares well in assessments against all but one of these criteria. It encompasses a wide variety of communication paths, audio, visual and documentary. After training, the system is not judged by its users to be difficult to use. The technology provides a learning environment that approaches the realism of face-to-face better than most others and communications and interactions are instantaneous. It does not offer independence of time and place and thus may be unsuited to other forms of distance education. But as mentioned previously, this is not a requirement of the school based distance education programmes in which it is used and as such is no impediment to its effective application.

Previous Research

Telematics as it is practised in Australian schools, is an application of technology mediated interactive learning (TMIL), forms of which have been used in distance education for many years. In the local context, Telematics is an explicit example of audiographics, and there have been a number of reviews of learning programmes delivered in this mode. Audiographics technology has received very favourable reviews from studies in the North American context. Positive findings have been reported from early studies in Canada and the USA (Frederickson, 1990). Identified outcomes have included strong attitudinal and motivational gains supporting enhanced learning environments.

Idrus (1993) describes applications in Malaysia where audiographics has been used in the delivery of teletutorials for university students studying at a distance. In this setting, the visual and audio interactivity has been found to contribute significantly to the learning outcomes achieved through the tutorials. To further enhance the capacity of the system, Idrus (1993) describes the use of an instructional strategy that encouraged collaborative learning among students. The collaboration between students at remote sites was seen as a critical factor in developing a successful learning environment. The author suggests that the success of the strategy was as a consequence of the increased levels of cognitive activity that it encouraged among the participants.

The importance of collaborative activities in TMIL environments is also reported in the earlier work of Dede (1990). Dede found that cooperative interactions were significant in successfully bridging the geographic and temporal barriers created by telelearning. The collaborative environments were seen as central components in providing and retaining an emotional dimension within the learning setting. The cooperative relationships among the learners established common purposes in the interaction and communication patterns and contributed to the creation of a functional *telepresence* within the virtual classroom.

A critical component of Telematics and audiographics applications is the high level of interactivity that is supported. The level and nature of interactions have been the focus of a number of studies among TMIL applications (e.g. Nahl, 1993; Ritchie, 1993). This research has identified the importance of student roles in interactive learning environments and clearly shows the need for teachers to be aware of the individual differences among students and sensitive to their needs and wishes. The roles of students in TMIL environments are significantly different to roles in conventional classrooms. The influence of interactions in the teaching and learning settings have not been found to yield the significant learning gains that have been expected. There is a need for teachers using TMIL to plan and use the interactive elements carefully (Ritchie, 1993).

Several reports in the Australian context have confirmed the potential gains of the technology (eg. States, 1992; Rehn, 1992; McGregor, 1992). In assessing the value of technological applications to teaching and learning, we must be careful to avoid the "visionary" trap described by Collis (1993). This trap is encountered when one assumes because a project proceeds and happens as planned, this can be used as a measure of its success. Measures of success need to be empirically based and empirical evaluations of Telematics are only just happening.

Evans and Nation (1992) describe an empirical investigation into Telematics in Victorian schools. Their preliminary report suggests the need for some caution in embracing the technology as evidenced from some shortcomings and impediments identified in their research. Some of the factors that can limit the effectiveness of the teaching and learning environments are:

- the very high levels of preparation and planning that necessarily must accompany lesson delivery,
- the problems associated with establishing discipline and authority in the virtual classroom,
- technical problems that can arise, and
- the changes brought about to work practices.

Evans and Nation (1992) observed the tendency for Telematics instruction to take a teacher-centred approach that was didactic and lacking in true dialogue between students and teacher. The need to embrace strategies and practises that take full advantage of the interactivity of the medium appears to be an important requirement of the training and instruction given to prospective teachers.

A study of the use of Telematics among student-teachers (Stacey & Turner, 1993) describes some very positive outcomes achieved in a teacher education programme. Through the use of Telematics in a LOTE practicum environment (the teaching of languages other than English), the researchers identified a number of positive gains for both teachers and students through Telematics interactions. The researchers report such findings as:

- increased levels of student participation in lessons,
- increased use of oral language by teachers and students,
- the improvement of children's listening skills, and
- more flexible and cooperative learning environments.

This research concluded that there was a need for Telematics to be addressed as an alternative mode for practicum participation and consideration given for the inclusion of Telematics into broader curriculum offerings within teacher education.

Apart from studies of instructional gains, a number of people have investigated instructional strategies and organisational strategies for the use of Telematics. The application tends to employ a number of consistent strategies and the literature abounds with hints and clues for the new Telematics teacher aimed at helping new teachers gain the maximum

advantage from the technology. For example, Smith, Fyfe and Lyons (1993) provide a series practical strategies that are a necessary component of good Telematics teaching. These strategies relate to organisational and management aspects of teaching.

Conclusion

Telematics has made significant in-roads in Australian distance education programmes in the past three years. The technology has proved itself to be robust and well able to support the educational applications in which it is used. While previous research has demonstrated the utility and efficacy of the technology, there is a now a need for research to further investigate the effectiveness of the teaching and instructional applications. This was the intention of the present study described in this paper.

3.0 METHODOLOGY

This research project was undertaken over a period of 3 months at the end of the first year in which the project had run. The research planned to investigate the success of the PCAP project measured against its stated objectives and also to address more general questions regarding the utility and efficacy of the use of Telematics in rural education. Responses to the research questions were to be gained by seeking the following information within the context of the PCAP project:

- the level of attainment of expanded opportunities for remote students,
- the effectiveness of the support and training mechanisms,
- factors influencing the uptake of these new technologies in individual schools,
- factors influencing the effectiveness of Telematics teaching,
- teacher responses and reactions to teaching with Telematics,
- student responses and reactions to learning with Telematics,
- the cost effectiveness of the project, and
- the changes brought about by Telematics to the training needs of teachers,

In the project a multi-method technique of data gathering and analysis was applied. This method had been developed and applied successfully to projects with similar goals in the USA (Reeves, 1993). This evaluation method for innovative projects involving new technologies is based on the work of Mark and Shotland (1987).

The chosen methodology adopted a qualitative data collection and analysis paradigm with strong measures to ensure the integrity and validity of the data and analyses. The depth and extent of the investigation brief necessitated the collection of many forms of data across the many different groups involved and associated with the teaching and learning. To organise the data collection for the study, tables were generated for each of the areas of research where required data was listed together with collection and analysis methods.

Data Requirements

Data requirements were tabulated for each of the research questions and linked to data collection methods and analysis requirements. The following tables show the data that were sought to enable accurate responses to be gained to each of the research questions. A variety of data gathering measures are listed including personal interview, telephone interview, questionnaire and observation. In instances where very rich data sources were likely to confront the researchers, recording processes were planned to enable analysis at a later stage. It was planned to make extensive use of video-taping, audio-taping and pictorial record keeping of the classroom activities and environments.

1. The extent to which the project increases access to a broader curriculum and improved learning opportunities.

Data Required	Collection Methods	Analysis
pre-NEP curriculum	Questionnaire to all school administrators and teachers.	Comparisons of subject availability, subject spread, teaching/learning processes employed.
post-NEP curriculum		
planned future curricula	Interviews with school administrators and teachers.	

2. Training and support mechanisms required by schools, teachers and students.

Data Required	Collection Methods	Analysis
Training procedures	Interview Project Coordinator, administrators, teachers and students.	Efficiencies of training and support mechanisms.
Support mechanisms		Identify problems encountered and implemented solutions.
Staff selection processes for Telematics teaching	Observe patterns of usage among teachers and students.	
Student selection process		Capacity of procedures and mechanisms to support and maintain efficient running of implemented projects.

3. Factors influencing Telematics uptake among schools and teachers.

Data Required	Collection Methods	Analysis
Reasons for school participation, and teacher involvement in project	Interview Project Coordinator, school administrators, teachers.	Establish patterns in participation rates.
Reasons for teacher involvement		Identify influencing variables and level of influence.
Place of Telematics in school programme, expected outcomes, concerns and worries	Observe patterns of usage among teachers and students.	Examine level of teacher interest and relate to perceived outcomes.
Physical and fiscal costs to school,		Compare plans for continued use and expansion across schools and regions.
Inclination to continue, future plans for usage.		

4. Effectiveness of Telematics teaching and learning

Data Required	Collection Methods	Analysis
Instructional strategies used by teachers,	Interviews with teachers students.	Investigation of teaching strategies and learning outcomes across;
teachers' perceptions of effectiveness,	Questionnaires for teachers and students.	level of planning, teaching strategies
efficiency of learning,	Observation of teaching /transmission.	management strategies, communications, instructional skills, and evaluation, in
student learning outcomes,	Observation of learning/delivery,	classrooms across schools.
	Student records and performance indicators	

5. Teachers' and students' responses and attitudes to teaching and learning with Telematics

Data Required	Collection Methods	Analysis
Level of satisfaction,	Interviews with teachers students.	Assessment of satisfaction levels across;
Perceived level of technological expertise,	Questionnaires for teachers and students.	subjects, schools, regions, classroom environments, management and coordination.
Comparisons with conventional teaching,	Observation of teaching /transmission.	
Preferred aspects of system and teaching process,	Observation of learning/delivery,	
Dislikes of system and teaching process,		

6. The cost effectiveness of the project

Data Required	Collection Methods	Analysis
Fiscal cost to Ministry, schools, students.	Interviews with coordinators, teachers, students.	Establish ratios comparing uptake, increased access, course delivery against identified costs.
Other costs, eg. time, shared resources.	Questionnaires to coordinators, teachers, students.	Comparisons with costs and outcomes of conventional programmes.

7. Teacher training needs.

Data Required	Collection Methods	Analysis
Skills required to use the technology,	Interviews with teachers.	Examination of skills and expertise required for successful teaching.
Teaching skills required for successful teaching,	Questionnaires to teachers.	
Problems facing the untrained teacher,	Interviews with Telematics trainers and coordinators.	Patterns of usage and training across successful teaching.
Problems facing the trained teacher,	Observation of teaching with Telematics.	Patterns of usage and training against perceptions of poor outcomes.
High level skills.		

Figure 3.1
Data Requirements, Methods of Collection and Data Analysis

Data Collection Matrix

The diagram below describes the data collection matrix proposed for this project. The sole use of qualitative data for analysis of research questions must be viewed with caution and adequate checks and measures imposed to enable valid and reliable conclusions to be drawn. This project employed several techniques to ensure the quality of the data and its accurate analysis. The multi-method used to source data enabled triangulation to be used to confirm findings and conclusions while the use of a team approach for data gathering and analysis brought differing perspectives to the analysis process.

Field of Inquiry	Method	Observation	Questionnaire	Interviews	Teleconferencing	Anecdotal Logs	Documentation
Expanded opportunities		●	●	●	●	●	●
Support & training		●	●	●		●	●
Technology Uptake		●	●	●	●	●	
Instructional Effectiveness		●	●	●		●	●
Student & Teacher Response		●	●	●	●	●	
Cost Effectiveness		●	●	●	●	●	●
Teacher Training		●	●				●

Table 3.2
Data Collection Matrix

DATA GATHERING PROCESSES

This project necessitated data gathering processes of several forms. These included questionnaire, interview and fieldwork and observation.

Interview Schedules.

There was a need to develop interview schedules to be applied to representatives and players in the broad range of groups associated with the project. The purpose of the interview schedules was to gain first hand descriptions of the project processes from key people. They were also used to further the information collected from the questionnaires.

The interviews were conducted in several ways:

- face-to-face was the preferred mode of interview and used whenever possible,
- the telephone was used to speak to teachers and administrators who were not interviewed face-to-face,
- teleconferencing was used in one instance so that teachers and administrators could interact in providing feedback to the evaluation panel.

Interview schedules were created for use with:

- administrators of schools,
- delivery teachers,
- coordinating teachers at receipt sites,
- area project administrators.

The interviews were used to gain descriptive data concerning the nature of the implemented activities at each site. The interviews provided information that aided in the analysis of the benefits of the new technologies and the conditions under which the benefits have been obtained. Comparisons could be drawn between planned and actual activities and factors influencing the levels of uptake and the effectiveness of the instruction and learning. Other factors associated with implementations were gained from interviews with students and school administrators participating in the project. This descriptive and anecdotal feedback provided a major part of the data that was used to assess the effectiveness of the new technologies, the outcomes both intended and unintended and recommendations and advice for further activity.

Observations.

An integral component of the evaluation process were the observations gained on-site of the teaching and learning processes in a number of key centres. To achieve this, the research team travelled to chosen schools sites to observe the technology being used in classroom applications. The observations included both lesson delivery and lesson reception. The observations were critical elements of the evaluation process and provided essential data for the evaluation of the use of the technology.

From the schools involved in the overall project, a selection was made for observation and face-to-face contact. This selection was made on the basis of obtaining a broad sample with the following considerations in mind:

- schools from each of the 4 regions,
- a blend of types of school eg, Senior High Schools, District High Schools, High Schools and Remote Community Schools.
- a selection that included the broadest range of curriculum and subject areas,
- schools from different educational sectors eg. Aboriginal/non-Aboriginal communities, Government/non-Government schools.
- cost and time considerations in carrying out the face-to-face component of the study.

The schools that were involved in the evaluation study are listed below. Those school in italics were visited as part of the evaluation while contact with the remainder was made by telephone and mail.

Kimberley	<i>Broome, Halls Creek, Sacred Heart College, Nulungu, La Grange, Looma,</i>
Kalgoorlie	<i>Kalgoorlie, Leinster, Leonora, Laverton, Blackstone, Warburton, Wiluna, Menzies, Warakurna, Yintarra</i>
Pilbara	<i>Karratha, Exmouth, Newman, Paraburdoo, Tom Price, Wickham</i>
Geraldton	<i>Meekatharra, Carnamah, Mt Magnet, Jurien, CBC Agricultural College.</i>

Delivery Teacher Interview Schedule

Equipment

1. What equipment do you use for Telematics teaching? Computer, fax, modem ?
2. How much did it cost?
3. Is it used for anything else?
4. Where do you deliver from? eg classroom, main office. Is this the best location?
5. What access do you have to the equipment for preparation etc? Is this adequate
6. What did it cost to set up Telematics in the school?
7. What had to be installed?
8. What are the communication costs? per lesson, per unit, per year

Becoming a Telematics Teacher

1. What caused you to get into Telematics teaching?
2. How much did you know about computers before getting into Telematics?
3. How long did it take you to become confident and competent with the hardware?
4. How confident and competent with the hardware/software are you now?

Training

1. What training have you received ?
2. How adequate has this been?
3. What were the strengths of the training programme?
4. How could the training programme be improved?
5. What do you find are the hardest things about using Telematics?
6. What further training would you like?

Creating Lessons

1. Describe the process of creating a Telematics lesson.
2. Average time taken for lesson preparation?
3. How does this compare with normal teaching?
4. Describe your preferred instructional method? How often?
5. What other instructional methods do you use? How often?
6. What level of graphics/instructional design do you employ in making lessons?
7. What hardware/software do you use ?

Delivering Lessons

1. What are the preparations needed to deliver a lesson apart from planning?
2. What problems occur?

Delivering Lessons (cont)

3. How often do these problems occur?
4. How much interaction do you have with the students?
5. What is the purpose of the interaction ? eg. attention, clarification, remediation
6. How well do you know the students?
7. Do all students in a lesson get equal value from this system?
8. What would be your best teaching hints to give to new Telematics teachers?
9. What support do you need at the receival point? eg teacher, aide
10. How important is the computer in the teaching process compared to voice and fax?

Telematics

1. How essential is the computer in the teaching?
2. How much of the features of EC do you use?
3. What are its strengths?
4. What are its weaknesses?
5. How good do you have to be to be an effective teacher with Telematics?
6. What makes a good Telematics teacher?
7. What makes a good Telematics student?
8. How much training do students require?
9. How often does the system not work? Is this a problem?

Teaching Effectiveness

1. How effective is this form of teaching? How does it compare with face-to-face, correspondence?
2. What strategies are most effective?
3. What strategies did you think would work but didn't?
4. What would make it more effective?
5. Do students enjoy this form of teaching?
6. Do they remain attentive?
7. What management strategies do you use?

General

1. What has been your best experience with Telematics?
2. What has been your worst experience?
3. What is the hardest thing about using Telematics?
4. Have you tried any innovations?
5. Will you continue next year?
6. Do you intend to expand your subject offerings using Telematics?
7. What will influence the expansion?

Table 3.3
Delivery Teacher Interview Schedule

Telematics Coordinator Interview Schedule	
<p>Equipment</p> <ol style="list-style-type: none"> 1. What equipment do you use for Telematics teaching? Computer, fax, modem ? 2. How much did it cost? 3. Is it used for anything else? 4. Where do your students receive? eg classroom, main office. Is this the best location? 5. What access do they have to the equipment outside lessons? 6. Is this time adequate? 7. What did it cost to set up Telematics in the school? 8. What had to be installed? 9. What are the communication costs? per lesson, per unit, per year <p>Becoming a Telematics Coordinator</p> <ol style="list-style-type: none"> 1. What caused you to get into Telematics teaching? 2. How much did you know about computers before getting into Telematics? 3. How long did it take you to become confident and competent with the hardware? 4. How confident and competent with the hardware/software are you now? <p>Training</p> <ol style="list-style-type: none"> 1. What training have you received ? 2. How adequate has this been? 3. What were the strengths of the training programme? 4. How could the training programme be improved? 5. What do you find are the hardest things about using Telematics? 6. What further training would you like? <p>Training Students</p> <ol style="list-style-type: none"> 1. Describe the training received by students. 2. How easy is Electronic Classroom to learn for students? 3. How long did it take students to come up to speed? 4. What support do students need in day-to-day lessons? 5. What do students do if things do not work as planned? <p>Managing Telematics</p> <ol style="list-style-type: none"> 1. What tasks does Telematics coordination require? 2. How much time does this take? 3. Do you get adequate DOTT for this? 4. If you left the school, how many others from the school could take your place? 	<p>Managing Telematics (cont)</p> <ol style="list-style-type: none"> 5. How long would it take to train your replacement? 6. What happens if you are sick, away etc? 7. How good does the manager have to be at Telematics? <p>Teaching Effectiveness</p> <ol style="list-style-type: none"> 1. How effective is this form of teaching? How does it compare with face-to-face, correspondence? 2. What strategies are most effective? 3. What strategies are not effective? 4. What would make it more effective? 5. Do students enjoy this form of teaching? 6. Do students remain attentive throughout lessons? 7. How important is the computer in the teaching process compared to voice and fax? <p>Student Response</p> <ol style="list-style-type: none"> 1. How much do the students like being taught by Telematics? 2. What aspects do they like best about it? 3. What aspects do they like least about it? 4. How much has it improved their computer literacy? 5. Are all students equally competent with the system? eg. girls/boys younger/older 6. Do all students interact equally with the system? <p>Curriculum Access</p> <ol style="list-style-type: none"> 1. What extra subjects are available through Telematics? 2. How valuable is this to the students and the school? 3. Has this lessened the perception of disadvantage due to remoteness at this school? 4. Are there plans to increase the use of Telematics to further the access? 5. Do you have much influence on what will happen to Telematics in your school next year? 6. Where are the decisions made about Telematics offerings in your school? <p>General</p> <ol style="list-style-type: none"> 1. What has been your best experience with Telematics? 2. What has been your worst experience? 3. What is the hardest thing about using Telematics? 4. Have you tried any innovations?

Table 3.4
Coordinating Teacher Interview Schedule

**School Principal
Interview Schedule****Telematics**

1. What factors influenced your decision to become a Telematics school?
2. What were your aims in becoming involved in the project?
3. How important do you regard Telematics in your school context?
4. What involvement have you had in running the programme?
5. What has been the social cost to the school?
 - other programmes lost or diminished?
 - funding channelled from other projects?
 - organisational difficulties?
 - rooming?
6. What have been the financial costs to the school?
 - equipment
 - training
 - capital works
 - communication costs
7. Based on your own judgements, would you consider Telematics to be cost-effective?

Outcomes

1. What do you consider have been the positive effects of having the Telematics programme in your school?
2. Has the Telematics programme achieved your intended goals?
3. How effective do you consider instruction delivered in this way to be?
4. Is there anything that could be done to improve the quality of the teaching and learning?
5. Do you consider there have been any negative effects?

Future Plans

1. Have you made plans for Telematics in 1994?
2. Do you intend to increase the offerings within your school?
3. Has any money been budgeted to maintain or increase activity in the area?
4. What factors will influence the level of Telematics activities in 1994 ?

Table 3.5
School Principal Interview Schedule

IMPLEMENTATION

A time frame for the conduct of the research was established and formalised and the initial planning for visits and consultations was set in place. The time line is shown as Figure 3.6. Initial contact was made with all the stakeholders in the PCAP project announcing the impending evaluation and research activity and informing people of the planned scope and nature of review. Letters were sent to:

- the four regional coordinators of the PCAP projects,
- the principals of the participating schools,
- the delivery teachers within the schools, and
- the coordinating teachers within the schools.

The time frame for the conduct of the research was very tight but a manageable programme was created. The planning of the school visits posed many logistical problems because Telematics lessons were typically only conducted one or two times in a day and the vast distances between some sites prevented more than one site being visited in a full day.

The programme of visits in some cases had to be planned taking into consideration the availability of the researchers, airline flight availability, Telematics lesson availability and schools having no planned deviation from established programmes. The final term in schools tends to have more than its share of disruptions to school programmes caused by sporting events, school camps, teacher professional development and external examination requirements for older students.

Much of the initial work of the evaluation involved planning and confirming the itineraries of the four trips and coordinating the process of gathering the data from the people involved. The questionnaire and interview schedules were prepared concurrently. It was planned to mail the questionnaires only to those people who could not be contacted for a personal interview. In the end, there were only a handful of teachers and administrators who were required to complete the questionnaire, the remainder were interviewed either during the visits to schools or through telephone and teleconference.

Dates	Activity
Week 1 September	Prepare questionnaires, interview Project Coordinator, prepare mailing lists, letter to all parties describing evaluation and projected time-lines.
Week 2 September	Questionnaire preparation, interview project training personnel and review training programmes, interview PCAP personnel at Ministry and relevant PCAP field officers.
Week 3 September	Mail questionnaires to administrators and teachers. teachers to administer questionnaires among students.
Week 4 September	Planning itinerary for trips, contact with schools to organise visits, telephone interviews with collaborating parties., interview Project Coordinator.
Week 1 October	School holidays
Week 2 October	School holidays
Week 3 October	Questionnaires returning, tabulating and analysing, preparing interview schedules, telephone interviews with administrators and teachers at sites not to be visited.
Week 4 October	Questionnaires returning, tabulating and analysing, preparing interview schedules, telephone interviews with administrators and teachers at sites not to be visited.
Week 1 November	Travel to Site 1 (Pilbara) Karratha SHS, Wickham DHS, Newman SHS, Paraburdoo DHS, Tom Price HS.
Week 2 November	Travel to Site 2 (Geraldton) Jurien DHS, Carnamah DHS, CBC Agricultural College, DEC.
Week 3 November	Travel to Site 3 (Kimberley) Broome HS, Nulungu College, Sacred Heart College, La Grange RCS, data organisation, report preparation.
Week 4 November	Travel to Site 4 (Kalgoorlie) Kalgoorlie SHS, Menzies RCS, Leonora DHS, Leinster DHS, report preparation.
Week 1 December	Report writing.
Week 2 December	Submit report

Table 3.6
Evaluation Programme

DISTRIBUTION OF SCHOOLS

Telematics removes the tyranny of distance. The map below shows the schools and the regions involved in this project. It is important to remember that there are now over 100 schools with Telematics in Western Australia and that connections are possible between any of them. The level of flexibility and versatility created by this possibility is one of the major strengths of the technology and a strength that appears to offer considerable advantage to the rural schools.

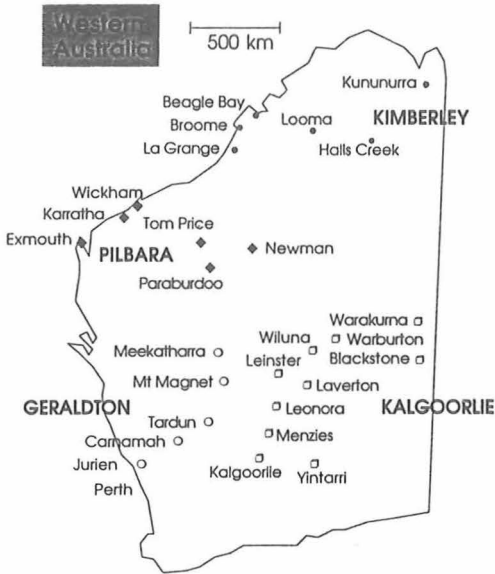


Figure 3.7
Distribution of Schools in Stage One
National Element Priority Country Areas Programme