# Examination of CAL Systems

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**Abstract**

*It can be seen that the distributed learning systems and the distance learning systems address different aspects of providing the facilities required in a Learner friendly System. Distributed learning support systems focus on the different methods and styles of delivering courseware to students or on supporting practical work by students, including the use of simulation for this purpose, automated submission of work and automated assessment of work. Conversely, distance learning systems are generally designed to facilitate or enhance communication between students and their tutor. A common theme in both models is their aim to provide adjunct support rather than completely replace traditional teaching methods. This perhaps reflects the opinion that practitioners are still uncertain about how to make best use of this new media and hence there is need for investigation of the facilities available.*

## Introduction

The aim of this section is to discuss some of the systems which have been developed and are particularly relevant to this study, with a view to highlight the need for further research in the area. An overview of projects will first be presented which discusses some of the common problems to be found within the evolution of CAL systems. Following on from this a taxonomy of system models is presented which can be used to group together the systems under examination. The relevant systems are then considered in subsets in order to establish the aims, achievements and problems in support systems which have been created for distributed and distance learning applications. The goal of this chapter is to establish a need for further research in the field by highlighting shortfalls with previous projects.

## Overview of CAL Systems

The systems which have been selected for review all relate to distance and distributed learning, and range from course-specific systems to generic authoring/learning environments. They encompass different types of communication between students and their tutors. Before reviewing the specific problems relating to systems which have already been developed in an attempt to provide support for distributed and distance learning, it is first worth considering some of the generic problems which have been identified when designing any CAL system.

## Problems and Misconceptions

A number of studies have concentrated on the technical, financial and political aspects of providing support using a distributed system [Pratt, 1985] [Cowan et al, 1988] [Erlinger, 1993] and have not considered the design and implementation aspects of providing such support, which is the aim here. A good example of the type of design problems which can be faced was illustrated in the misconceptions of education identified by Kay [Kay, 1991].

*'One misconception might he called the fluidic theory of education: students are empty vessels that must be given knowledge drop-by-drop from the full teacher- vessel. A related idea is that education is a bitter pill that can be made palatable only by sugar-coating.'*

The first of these misconceptions relates to a point which was raised in the previous chapter, that concerning active versus passive CAL. This misconception implies that CAL should be passive in nature, simply presenting material to a student. The second is particularly prevalent in the development of CAL. It can be seen as the need to make use of the latest technology available without prior consideration into how that technology can be used in a useful and meaningful manner [Lidtke and Moursund, 1993] [Bates ,1995] [ Teaster and Bliesner ,1999]. This is difficult to achieve in CAL

and the danger is that a developer of courseware can fall into the trap of focusing on the use of technology rather than the educational value of the system. This can also work against a developer in a different way; for example, by making the software excessively complex to use. The students would then have to learn how to use the software package; the result of which would be to divert their attention away from the pedagogic points to be learnt.

Many of the other CAL-related problems are concerned with the attitudes and approaches of the staff involved. These issues include a lack of time to develop material which makes use of the new medium and a skepticism of teaching staff towards the effectiveness of CAL-based material for particular subject areas [Chambers and Sprecher, 1980] [James, 1986] [Hammond et al, 1992] [Omoregie, 1997] [ [Alan Clarke,2001].

**System Models**

In the following section, a number of key systems which are relevant to this study will be considered. Prior to this, however, it is useful to categorize these systems so that the evolution of systems of similar nature can be considered together. It has been suggested that there are distinct models which are used in the delivery of teaching and learning material in higher education and the roles which computers play in these models [Lewis, 1991]. Four models have been put forward: the campus model, the OU model, the Open Learning model and the Information Technology-based Open Learning (ITOL) model. The first of these, the campus model, considers the typical situation at a university in which students are present on a campus, attending lectures, practical classes, and so on. In this model, the use of computer technology is to support existing teaching practices,

For example with generic tools such as word processors or with specialized courseware, and as an alternative to human interaction, for example email could be used if a tutor is not immediately available for a meeting. Because of the nature of the model however, it is noticeable that most development goes into the design and creation of specialized courseware.

The OU, or Open University, model on the other hand, considers distance learning situations in which the students study assessed courses in order to gain qualifications. Traditional methods of administering material for distance learning courses include radio and television programmes, videos, self-study paper material, summer schools and occasional face-to-face or telephone meetings. By necessity, students in this model are considered as individual learners as these are very much one-way media, and there is little scope for interaction between students. It is obvious that the provision of better communication channels would be of great benefit, helping to overcome some of the limitations implicit in distance education. Hence the systems considered under this model concern the creation of the so-called *electronic or virtual universities* [Butts et al, 1994] [Eisenstadt, 1994] [Rada, 2001].

The Open Learning model relates more closely to vocational training. This model differs from the previous two in that students do not follow a defined course syllabus leading to a qualification, but learn the information which they need to learn, when they need to learn it. Hence this model's relevance to training, allowing people who cannot leave their place of work to learn new information as it becomes available. There are obvious similarities between this model and the distance learning model in that the students are spatially separated from each other as well as from the learning centre.

The final model which was offered was the Information Technology-based Open Learning (ITOL) model. This was formed from a study at Lancaster University into improving the flexibility and responsiveness of vocational training. One of the key benefits of ITOL is that it would allow learners to define their own learning and personal development needs, a concept specified in the Learner Friendly System definition. The purpose of this model is to bring the electronic communication support previously mentioned in the campus model to the open learning model. However, the validity of this model has been brought into question in relation to its application to higher education [Gardner, 1991].

As Lewis acknowledges, there are elements of each of the models in each of the others [Lewis, 1991]. One of the purposes of this project is to explore the increased possibilities for providing computer support for teaching, a concept which is implicit in the fourth model. For this reason, the

Open Learning model can be discarded as the use of computer technology is not central in this model, as opposed to the ITOL model. Of the remaining three models, the Campus model looks towards providing support for users who are present at an institution, and both the OU and ITOL models look at users who are at a distance from the institution and their peers. In other words, the Campus model covers distributed CAL models and the OU and ITOL models, which both have similar requirements, cover distance CAL models. The difference between the distributed and distance groups is that emphasis is placed more firmly on the communications aspects of providing support in the second group of systems as a means of overcoming spatial barriers. This is not really an issue in the distributed group. Hence in the following section, systems are considered in two groups, distributed and distance systems. A further distinction is made between systems; those which pre-dated the World Wide Web and those which were developed after its inception, making use of some of its considerable potential.

**Need for Research**

The purpose of the above review is to highlight the need for further research in the field of distance and distributed systems for Computer-Aided Learning. There are a number of observations which can be made about the systems which appear in each of the categories outlined above. At the most abstract level, it can be seen that the distributed learning systems and the distance learning systems address different aspects of providing the facilities required in a Learner friendly System. Distributed learning support systems focus on the different methods and styles of delivering courseware to students or on supporting practical work by students, including the use of simulation for this purpose [Alder et al, 1990] [Bolton and Every, l990] [Svanaes, 1990], automated submission of work [Luck and Joy, 1995] [Aggarwal, 2000] and automated assessment of work [Jackson, 1991] [Fry, 2003]. Conversely, distance learning systems are generally designed to facilitate or enhance communication between students and their tutor. A common theme in both models is their aim to provide adjunct support rather than completely replace traditional teaching methods. This perhaps reflects the opinion that practitioners are still uncertain about how to make best use of this new media and hence there is need for investigation of the facilities available.

When examining the distributed learning systems it becomes apparent that there are two obvious approaches which have been adopted: the creation of a system in which courseware can be developed and distributed, or to fund and support the design and implementation of courseware in the hope that a system becomes apparent. Historically , the former has been most popular and has the benefit of channeling most effort into the creation of courseware(it was noted, for example, that in a given time period both Andrew and Athena reported the same number of individual projects, yet a large number of Athena projects were conversions between different platforms[Issacs,1980]). A further benefit of adopting this approach would be the uniform nature of the interface to any courseware which was derived. Support for this requirement of a fully integrated environment can also be found in the distance learning systems and the evaluation study for the Open University's Virtual Summer School [Issroff, 1994]. This project made use of software from a number of different sources and in final analysis was observed to be unstable and error - prone; the different packages employed for each of the facilities proving difficult for the students to install and configure. Indeed, it was found that certain combinations of software, when used together, would result in a student's work being interrupted or even the student being locked out of the system. These two problems support the claim for a teaching system to be fully integrated and to provide a framework in which courseware could be implemented and distributed both in on – campus and in more wide area situations.

Both distributed and distance learners can benefit from increased support for communication. At a local level, computer – mediated communication can, for example, be used to overcome temporal barriers allowing students to make contact with their peers and tutors if they are not available for face-to-face consultation. The application of computer communication techniques to distance learning can bring with it more obvious benefits where there are also spatial barriers which need to be overcome. Therefore it is in the field of distance learning that most research and evaluation

of the different forms of communication which can be supported using computers has been performed. Whilst the vast majority of studies have reported positive outcomes which support the use of this medium for learning applications, there are a number of limitations which have been observed in the systems under evaluation, typically generic conferencing systems. Examples of such limitations include the nature of material which can be transmitted as courseware, and the problem of depersonalization. The former is most vividly exemplified in courses such as Mathematics and Physics in which the displaying of formulae could prove difficult if a solely text-based medium, such as email, is employed. The latter problem can occur in any situation which makes use of computer communication for tutoring and was outlined in the above section on Web-based distance learning systems.

To some extent, the facilities offered by the World Wide Web could be used to overcome these problems. The multimedia abilities of the Web could certainly be used to overcome the display problems of text-based systems and, as is suggested in the work of the CODILESS team, the problems of depersonalization. However, it is common to find that the use of the World Wide Web in many education-oriented systems is solely for access to electronic versions of course notes. Using this new medium for distributing material to students holds obvious benefits such as lower costs through the diminished use of paper and the increased control available to tutors over the contents of their courseware by facilitating the ability of a tutor to provide updated and new course notes to students quickly and effectively. Whilst this is addressing one of the problems associated with supporting distance learning, the dissemination of courseware, other major issues in overcoming the factors relating to the spatial barrier are left unanswered. As well as providing support for both asynchronous and synchronous communication between students and their tutors, and the distribution of materials to students, there is also a need to increase the level of interactivity available to distance learners. Some on-campus courses place more emphasis on the practical side of learning, putting into use the theory which has been taught. As part of Computer Science this is evident in the use made of programming exercises, for example, whilst other sciences make use of laboratory classes. Support for laboratory classes can be catered for using the various methods of computer simulation which are available, such as graphical systems [Svanaes, 1990], text-based systems [Alder et al, 1990] and multimedia systems [Bolton and Every, 1990] [Watkins et al, 1995] [Morris, 2000].

**Summary**

The discussion focusing on the different approaches which have been taken in the past in attempting to provide distributed learning environments can be split into two distinct categories; those which have concentrated on the delivery of material to students, such as COSTOC and COLOS, and those which have focused on the provision of communications support for course attendees.

Other observations that can be made concerning these previous projects is that some are very explicit in nature: StudieNet for example was designed with the specific goal of providing support for a particular course in Mathematics. The problem which this raises is that CAL material is expensive and time-consuming to produce, and without a level of adaptability requires a new software package to be created each time a course needs support. This problem is also illustrated in the Athena project in which it is reported that a large number of the projects were conversions between different computer platforms. There is also the possibility of the difficulties reported by the Open University concerning their Virtual Summer School in which conflicts between the different software packages at times rendered the system unstable as a whole.

The result of this is the apparent need for further research into the design of a Learner Friendly system, an integrated system to offer different levels of support to students over a computer network. The system must be flexible in that it should be easily adaptable to other courses and subject areas, and yet integrated to offer stability in its operation, as an unstable system will affect a student's learning ability using the system.

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