1997

Computer-assisted learning : its uses and application in maritime education and training

George H.K. Mwanza
World Maritime University

AVQR

WORLD MARITIME UNIVERSITY

Malmö, Sweden

COMPUTER-ASSISTED LEARNING:

its Uses and Application in Maritime Education and Training.

By

GEORGE H. K. MWANZA

Malawi

A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

MARITIME EDUCATION AND TRAINING
(Nautical)
1997

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

....(Signature)

....10/10/97.................................(Date)

supervised by:

Captain Bertil Wagner

Lecturer

World Maritime University

Assessor:

Dr. Bernhard Berking

Visiting Professor, WMU

Fachhochschule Hamburg

co-assessor:

Professor P. Muirhead

Resident Professor MET

World Maritime University

ACKNOWLEDGEMENTS

I would like to thank Captain Bertil Wagner for his untiring assistance and advice through out the period of researching and writing this paper. His help has been immeasurable.

I would also like to express my gratitude to Professor P. Muirhead for providing some of the reference materials which proved to be very helpful for the development of some of the ideas included in this paper.

I also wish to thank the academic and library staff of the World Maritime University for their support to this research.

Dedicated to the most important people in my life:
Thandiwe, Eric and Effie

ABSTRACT

This paper is concerned with the use of personal computers in Maritime Education and Training. It examines how CAL can help optimise the learning outcomes.

A brief look is taken at traditional maritime training methods used in Maritime institutes. A comparison is made with training methods employed in the aviation industry with the view to find out what lessons, if any, the maritime industry can learn from there.

The definition of Computer-Assisted Learning and the role it can play in a skill-based training environment are considered. The capabilities and limitations of CAL are investigated.

The general considerations in implementing CAL in an institution and the selection of software for use in training are examined. The principles of good quality software are examined, taking into account that at present most of the educational software available if of the commercial "off-the-shelf" which might not be exactly suitable for classroom use.

Two maritime software programs, Officer of the Watch and Navi-Trainer, are analysed . The methods for collecting data on the appropriateness of a particular software in meeting specific instructional objectives are investigated.

The paper concludes that CAL is suitable as a part-task training tool in Maritime Education and Training. It can be used for pre-simulator periods or in concert with other training methods. However, its value is reliant on proper planning, implementation, execution and usage.

TABLE OF CONTENTS

CHAPTER ONE

1 Introduction

1.1 Objectives of the study

Over the last two decades there have been many new developments in all areas of science, engineering and technology. These developments have had a considerable impact on education and training. One major consequence of this progress is that many new methods and techniques have become available for teaching and dissemination of instructional materials.

The developments in electronics and computer science have produced a number of new and exciting technologies. In the context of educational design, two most important of these are:

(a) low cost techniques for image storage, manipulation and presentation

(b) new methods for facilitating human interaction with computers

One tangible result of what has been pointed out above has been the development of simulators. One field that has benefited from this development is the Maritime Industry. Over the years it has been confirmed that radar and navigation simulators are powerful training tools. They have been increasingly used usually because of the high cost or difficulties in training personnel on real equipment. Nevertheless, there are some areas where simulators are perhaps not the most ideal solutions and alternatives have been sought.

One of the alternatives is the use of Computer Assisted Learning (CAL). It has seen a steady growth of interest in recent years due to reduction in price, the increase in computing power of computers and the introduction of interactive software specially geared towards the development of interactive courseware. However, it is common to observe that many institutions use micro-computers more as a tool to teach computer literacy and programming than as a device for Computer Assisted Learning. The main reason for this being probably due to the fact that most teachers/lecturers still lack the confidence to explore the CAL approach, resistance to change and proper plans to incorporate CAL into the curriculum.

This study investigates the validity of computer-assisted learning in the maritime environment, and its use as a teaching and learning tool with specific reference to its use as an applied training medium for mariners. To put this thesis in the right perspective, the study tries to answer the question that is traditionally training methods provided by the established training establishment adequate for seafarers? Furthermore, it makes a comparison between the aviation industry and the maritime training regimes to try and find out what lessons the maritime industry can learn from the aviation industry. It also examines how CAL can be used to meet the training requirements as laid out in the STCW'95. It investigates what steps to follow for successful implementation of CAL and criteria to be used in selection of software.

1.2 Methodology and Approach used

To achieve the stated objectives set forth in this study, several fundamental areas are examined:

- the training methods commonly used in maritime field.
- the nature and characteristics of computer assisted learning.
- the degree of skill transfer from training on a PC to the work place.
- the role technology can serve in teaching, learning and the curriculum.
- the selection, evaluation and use of educational software.

The paper starts off by looking at the demands placed on maritime education and training in light of the rapid development of technical equipment on board ships, the regulatory pressure to protect the environment and the economic demand to operate ships cost effectively. These demands require new training targets. The paper therefore goes on to look at what training modes can best meet these new requirements. It therefore examines briefly traditional classroom lecture method, the use of full mission simulator, part-task desk top simulators and computer assisted learning in general.

The strength and weaknesses of CAL in a learning process are evaluated and points are suggested for its successful implementation in an educational institution. As successful application of CAL depends on the software selected, the paper examines principles of good quality software and suggests the process which can be undertaken in order to identify promising software.

Finally, the study concludes with an analysis of findings. The question of whether CAL is suitable for implementation in maritime education and training is discussed. The problems that may hinder implementation of CAL are summarised.

1.3 Scope and limitation.

This study consists very much of literature review aimed at unveiling the theoretical feasibility of the use of CAL in maritime education and training. The emphasis is on trying to develop an understanding of the effectiveness of CAL in the maritime environment. In this endeavour, the limitation encountered is that although CAL has been around for sometime, information on the subject is still limited and hard to come by. In this respect therefore the literature review may not have been thoroughly exhaustive.Some of the information was gathered through participation in Maritime Education and Training course of studies at the World Maritime University, in running software programmes for evaluation.

One area which would have been of interest to look at and which has not been covered by this study is the use of the World Wide Web and satellite communication technique for dissemination of instructional resources. The World Wide Web with its multi-media nature is a natural setting where interactive training can take place and satellite broadcasting's potential application in education especially for distance learning.

CHAPTER TWO

2 Computer Based Training in Maritime Education and Training

2.1 Traditional Maritime Training Methods

Traditional approaches to the professional development of officers in the merchant navy have produced many competent mariners, although not always systematically and with varying individual qualifications. Maritime accidents often involve experienced and competent mariners and most accident's investigations show the identification of an error chain involving these mariners.

The maritime field places greater reliance in training on colleges and those seafarers that have come ashore. In colleges' methods used include lecturing to the class, use of an overhead projector or white board and the occasional use of video to amplify training objectives. A training ship is brought into use whenever possible to provide hands-on experience to the students. This however is dying out as colleges working on meagre budgets cannot afford to operate and maintain the ships.

Cadets can work on attachments on commercial ships to further acquire practical experience. There are two ways of conducting training on board ships. Firstly, cadets follow task and guided study program that is as distance learning from the mother college and secondly as on job training with senior officers acting as mentors. The latter has shortcomings in the sense that it is an extra burden on the master and experienced officers without extra remuneration. The ship's officers do not necessarily have pedagogical skills. Adding to this, the types of vessel, the line, the uncertainties of the voyages are not always favourable for on-job-training and experienced officers do not take risks to analyse cadets' reactions. This therefore leads to uneven standards of training offered to trainees on board different ships. It also affects the quality of the sea service element of the candidates' education. This is also partly due to the reluctance of mentors to take on the extra burden of teaching the cadets. The are also differences in the capabilities of the mentors in carrying out their supervisory role. This then begs the question that is the ship's officer the best person to provide on-board training?

The difference in the types of vessels on which different sea service is carried out exasperates the situation farther. For example, three months at sea in a cruise liner offers very different training gain from three months in a dredger.

One strong handicap experienced in the maritime field has been that development in maritime training has been conservative, with strong reluctance to replace past practices. There has been a tendency to teach topics that are generally antiquated because the knowledge might be needed in times of emergency. As a result of this, it has been the way in the maritime training field to maintain the status quo with little in a way of new innovative training methods, training requirements and training equipment to support the training curriculum. It has been the case until the revised STCW 95 that new training objectives and the means of attaining these objectives have been stipulated.

In his paper which he delivered in Singapore, Short (1995) points out that in many respects, this system of training and certification worked well, but within the context of generally smaller and slower ships, larger crews and less congested shipping lanes, with little concern over the protection of the marine environment. With the current situation where you have reduction in crew size that has been made possible through accelerated use of advanced technology, automation and novel ship designs, the skill matrix of the crew will have to change by necessity. There is currently a serious gap between the quality of manning needed by the industry and the quality of manpower supplied. A change in the situation can only be brought about through effective and efficient training of the crew as there is a link between training and performance that must be recognised and strengthened.

2.2 Skill Based Training Environment

Van Donselaar(1996) has defined training as the systematic development of skill behaviour pattern required by an individual in order to perform adequately a given task or job. It can also be defined as the process of managing people's experiences so that they gain the requisite knowledge and skills that give them the potential to perform. This is achieved by exposing the individual to relevant experience through the performance of tasks selected to meet specific training objectives. Through careful monitoring of procedures, performance standards can be measured against established criteria to an acceptable level. The extent to which this potential is created depends on the nature of the training experiences as well as the aptitudes and abilities of the students being trained.

One question that is recurrent is that of the degree of skill transfer from the training environment to the work place. In skill based environment, as is the case in the maritime environment, the tasks carried out in training have to be structurally similar to a work place task and very well learned for there to be a positive transfer. Christina (1996) argues that when the training tasks differ from work place tasks, the degree of dissimilarity interferes with the quality of the performance of trainee in the work place. He goes on to say that the greater the proportion of the components of the training task which match those of a required work place performance, the greater will be positive transfer. The degree of skill transfer will also depend on the trainee recognising the components which are similar between both settings and actively promoting their transfer. The greater the perceived similarity of the training and work place the greater the amount of transfer. No transfer takes place when similarities are not recognised. Training activities are detrimental to work place performances when items are perceived to have few shared components and many distinct/ irrelevant ones. Transfer will be more difficult the greater the proportion of irrelevant to relevant elements in the training tasks. Task elements i.e. isolated features of a skill needed for competition, when learned out of context (in a largely irrelevant skill) will be difficult to transfer. The quality of their execution is distorted by interference from irrelevant elements.

Elements learned at training are more likely to be transferred to work place settings when the way they are practised in training is similar to the way they will be used in the work place. The compatibility of practice and work place tasks modifies the amount of beneficial transfer. Christina (1996) maintains that it is not merely the similarity of conditions between training and work place tasks that is important but the similarity of the underlying cognitive processes between the two. The mental processing and control of tasks is of such importance that when it is done correctly, it will more than offset changes in the conditions of the work place tasks. Therefore it is not sufficient to have only the physical characteristics between the tasks similar but the mental activity accompanying those skills also has to be of like quality and content.

Maritime education as a whole is based on the trainees acquiring the required competency in order to occupy a position as a ship's officer on board any given ship. Muirhead(1995) explains that competency in this case involves the gaining of the knowledge and skill to the standard of performance required in employment. In this regard therefore, the issuing of certificates of competency to persons to entitle them to work on ships, implies that they have been found qualified to perform certain tasks on board. The certificate is the main evidence that the individual is capable of performing certain practical tasks and functions on ships in a safe and effective manner. Consequently, the certification is supposed to be based on the attainment of competency rather than on the completion of a training program.. This has been especially highlighted in the revised STCW '95. Brindle (1992) has argued that competency in general and in a skill based environment therefore includes all aspects of work performance like:

- task skills

the requirement to perform individual tasks

- task management skills

  The requirement to manage a number of different tasks within the job.

- contingency management skills

  the requirement to respond to irregularities and breakdowns in routines

- job environment skills

the requirement to deal with responsibilities and expectations of the work environment and most important of all the requirement to transfer and apply skills and knowledge to new situations and environment. When this has been achieved, the training develops in the learner a sense of self-efficacy. Efficacy in dealing with one's environment is not simply knowing what to do, rather efficacy involves a generative capability in which the cognitive, social and behavioural subskills are organised into integrated courses of action to serve innumerable purposes.

To achieve the foregoing, the competency based training must;

- be based directly on the skills and abilities required to do the work.
- take into account the learners existing level of competency
- allow learners to enter training programs at various stages of their professional development
- suit the learners pace and style of learning
- allow training to take place in a variety of settings
- allow a learner to be assessed when they are ready
- provide learners with a record of competencies they have achieved

As competency embodies the ability to transfer and apply skills and knowledge to new situations and environment, it must be demonstrated and assessed under conditions as close as possible to those under which the competency will be practised.

2.3 Comparison Between the Maritime Training Regime and the Aviation Training Regime

The shipping and aviation industry have evolved in different cultures. This is especially true in terms of how the two industries view safety in their operational environment. In the aviation industry safety is a basic element of all their operations. On the other hand, although safety is also important in the shipping industry, there is a lower perception of immediate danger. This can be illustrated in the following way; a pilot is required to undergo a concentrated course each time he flies a different type of aircraft even though types may be similar. In shipping, a master can be transferred from commanding a bulk carrier to a container ship without additional training even though there might be some systems which might be different on the two ships. The thinking behind this is that the master will be able to handle the particular ship based on his training and experience on other vessel types. In aviation nothing is left to chance if it can be helped.

Eldridge (1996) states that another significant difference between the two training regimes is that training for aircraft crew is narrower, deeper, and more frequent than that of a sea going officer. The training targets are clearly defined making it easier to arrive at the most efficient and effective way of delivering the desired training outcome. It is easier to define the training output in the aircraft crew training because flight operations are equipment specific in nature. Furthermore, the safety culture in the aviation industry promotes greater participation in training in addition to the regulatory pressure and pay structure that has a bearing on motivation. This safety culture is kept up partly because aviation disasters are spectacular and also in this industry the people involved in training are those that are currently working as pilots on such type of planes. This is different form the situation in the maritime training field where greater reliance is placed on the experience of those that have come ashore, who may not necessarily have experience which is current. The aviation industry is consequently dynamic, confident and self-contained industry whose training regime is underpinned by safety.

Equipping a seafarer for safe bridge operation is a more generic process. The trend on board ship is less specialisation hence giving the candidate a wider but less deep knowledge. Training targets are extensive . The industry would like to have an individual who can navigate the ship, maintain the engines, carries out cargo operations, carry out the radio operators' tasks and be a medical assistant also.

One training method used extensively to achieve the desired outcome in the aviation is computer based training. In the early 1980s airlines faced the critical need for effective training to ensure passenger safety and at the same time to reduce the training costs. The airlines believed that, for example, if a technician or a pilot could learn a skill or develop his professional knowledge without tying up an expensive simulator or aeroplane, they could save literally millions of dollars a year. Computer-assisted learning (CAL) promised all these possibilities and as a result there was a huge rush towards CAL in the aviation industry during that period.

It was possible to introduce CAL in aviation partly due to the fact that aviation is a high tech industry where technologies allow computer based techniques used in actual flight control systems to drive the simulated training. Secondly commercial viability of CAL in aviation training had been assured by a clear market demand that led to a large investment in computer based training. Some of these computers based techniques have successfully migrated from aviation to shipping. In the last few years technology has sufficiently developed to make this commercially viable.

Powerful micro-computers, interactive workstations and networking have led to a considerable output of software for use in maritime education and training.

2.4 What is Computer Assisted Learning?

Computer assisted learning is a term applied to teaching and learning situations that involve the direct instructional interaction between a computer and student. Simply put, it is the use of computers and multimedia technology for training in a way that promotes student interest and motivation. Computer-assisted learning provides an environment where the learner is instructed by a computer generated learning sequence. The learner interacts indirectly with the instructor through the computer. In such settings, the learner interacts with a computer program that controls and directs the instructional sequence. Computer generated learning sequences are able to be used for such applications as :

- tutorials
- competency based training and assessment
- information dissemination
- skills development
- simulation

The computer's multimedia capability to show graphics, and play sound, video, and animation greatly enhances the learning experience. Its ability to adapt and respond to a learner's needs, difficulties and progress by comparing student responses to a set of prescribed rules contained in the software program also improves the learning outcome. Easton (1996) maintains that on the whole the main objective of using CAL in a training process is not merely to duplicate the characteristics and effectiveness of the traditional class but rather to use the computers to actually do better than what normally occurs in the face to face class.

2.4.1 Software

A computer software program is developed by a "course ware" author for use as a learning vehicle. Courseware is the term used to refer to the CAL program, i.e., software with complete lesson content, questions, branching logic, among others. The program can be designed such that the specific training content, depth, and delivery style adjusts to the needs of the individual student. The computer has the capacity to analyse the student's responses to questions and other activities, and respond appropriately. This can only happen if the courseware developer has built it into the CAL program.

Typically, the student interacts with the CAL by answering questions, or indicating appropriate steps to be taken in a simulation-type activities. The usual input devices include the keyboard, mouse, light-pen, touch sensitive screen monitor or even a voice recognition device. An extension to this includes custom designed mock-up devices that simulate the "look and feel" of equipment in the work place, but which are connected to the computer for use as CAL input devices.

Computer assisted learning can be delivered on a floppy disk, or over the internet, but it is more often distributed on a CD-ROM, capable of storing 660 megabytes of computer data on one plastic disk. CD-ROM's are ideal in situations that require large data files, such as the use of video or animation; one disk can often hold several training modules.

2.4.2 Applications

2.4.2.1 Tutorial

When CAL is in a tutorial mode, it centres on providing professional development to the user by using multimedia with the computer as a control and presentation platform. With interactivity between the machine and the learner, the learner uses the senses of sight, sound and sometimes touch to gain an insight into the material being presented. The tutorial software is usually designed with the assumption that one person at a time will engage with the computer although networking is possible.

Tutorial programs have built in responses to sets of anticipated correct and incorrect student answers. To narrow the range of answers, many tutorials employ a multiple choice format in their questions. Tutorial management system monitors the student progress through the skill sequences and maintains records that can be transformed into detailed reports for the teachers.

2.4.2.2 Intelligent Tutoring Systems (ITS)

Software developers have now developed very powerful tutoring systems that can provide tailored instruction to individual students. The systems use artificial intelligence systems to create testing sequences for learners from which individualised instructional sequences can be developed. Students learning through an ITS system interact with an apparently intelligent tutor that customises the learning course appropriate to the learner's previous knowledge. Modern ITS systems use interactive multimedia and hypermedia systems to create learning sequences. Student progress through the system is based on success in assessment procedures. Where learning problems are identified, remedial instruction can be chosen by the system and provided to the learner. Most systems are in prototype form but their existence indicates possible directions that CAL may take as hardware and software systems improve.

2.4.2.3 Drill And Practice

By a drill it is meant some fixed number of tests organised around a central theme, like a graphic picture of objects, and taken in sequence and where the user's score of correct or incorrect answers is kept track of and displayed. Drills can also have a learning mode in which a correct answer or information can be displayed upon request from the user by either clicking on an icon or some other method of input. It is used for reinforcing concepts previously taught and for skill development by providing the repetition necessary to move acquired skills and concepts into long term memory. Rushby (1995) maintains that the acquisition of skills requires a high degree of overlearning to ensure that the learner's performance does not suffer even after lengthy time periods without practice.

Some essential assumptions of the drill and practice programs are:

- that basic skills are learned like physical skills through repeated practice.
- more complex ideas can be broken for the students into appropriate sequences of sub-ideas and sub-skills.
- students will replicate behaviours that are reinforced with pleasant experience.

Even at its best drill and practice doesn't pretend to teach, it provides well-organised, self-correcting drill on skills the students have been taught already.

It has its advantages:

- the computer can provide immediate responsive feedback and sustained attention to the student if need be
- several sorts of feedback, not normally available in classroom, speed of response and information regarding level of performance compared to past performance
- the instruction can be highly individualised

Although tutorials and drill and-practice packages have their uses, many of them encourage rote learning and the learner does not have the opportunity to apply the information within a context that is relevant.

2.2.4.2 Simulation

Software that includes simulations attempts to represent some aspects of real or fantasy situations. These may include situations that may need to be speeded up or slowed down to be better understood or situations that may be too expensive to experience directly. Simulations are controlled via a programming language used, by a mathematical model that attempts to take into account all variables that are related to the situation or phenomenon being simulated.

The computer imitates over time the behaviour of a process, organism, piece of machinery, or any dynamic, time dependent, non-stochastic relationship between parts of a whole. In the representation of the real-world situation, during the simulation a specified number of factors can change, as they do, they produce other changes throughout the simulated world. Since many relationships are complicated and their outcome unpredictable, the simulated program produces a problem-solving situation in which decisions are made in light of past experiences and projected into the future. Waddell(1982) explains that a simulation creates a living case study or a real-life situation in which participants apply their new knowledge and skills and obtain immediate feedback on appropriate behaviour. Simulators are used in education as a modified version of discovery learning. It has been proven that learners will learn best by actually completing the task rather than simply learning about them. But Waddell warns that a simplistic view of reality may result since simulation involves a portrayal of selected events and frequently only there components.

Simulations may be simple or complex, they may be run in batch mode or real-time, and their representation to the user of inputs and outputs over time may vary from crude tables of numbers to fancy real-time graphic displays. Pedagogically, simulations are advantageous, they utilise both the computational and interactive powers of a computer to achieve safe and inexpensive laboratories for any dynamic process, be it simple or complex, easy to grasp or nearly impossible to fully comprehend theoretically.

The creation of a dialogue or interactivity between man and machine through gaming and simulation extends the ability of CAL beyond the mere acquisitions of knowledge and understanding produced by linear type programming.

New educational technology and methods like the use of computer assisted learning and simulators can be targeted towards achieving some of the pedagogical problems experienced when training for competency; like in improving equipment operational skills and procedures, improving the quality of training, refreshing , updating existing skills and assessing the competence of trainees and others in practical skills.

The following training targets can be reached in learning skills by means of a simulator whether it is a full mission or "desk top" PC based simulator;

- Controlling complex skills of perception on the basis of observation and performing a require series of actions
- work procedures, in particular procedures which do not occur often in reality and emergency procedures which leave next to no time to consider, the situation can be trained for.
- Immunity to stress can be increased by increasing the complexity of the tests in a concentric degree of difficulty
- increasing problem-solving ability. the principle of feedback of a simulator allows a discussion of all the pros and cons of a chosen method or course of action.

While it may be argued that learning on the job is the preferred method of providing learning experience, the fact still remains the same that in some industries, it is too expensive and dangerous to allow learners to practise on the real system. In the maritime field, the simulator with its ability to recreate situations under varying conditions controlled by the instructor, capable of ready repetition, has opened the door to the possibility of training mariners in practical skills without risk to their ship or lives. The seafarer can be exposed for the first time to range of shiphandling experiences with the visible day or night scenario before him, using a training medium that exposes him to many lifelike situations at sea and port without risk or damage other than to that of his ego. The experience of a life time can be encompassed in a very short time.

For many establishments, full scope simulators are essential for training, but for many others the answer lies in computer assisted learning. This is especially true for those maritime colleges that can not always afford a dedicated simulator. The use of desk top computers can provide a sophisticated system capable of much wider range of tasks and far greater utilisation adding to the fact "desk top" simulators are much cheaper than the full mission simulators. Even for those institutions that can afford to buy these full mission simulators, the use of supporting part-time devices needs to be recognised as an integral part of the training process if such simulators are to be effectively used, especially where large numbers of trainees are being dealt with. Having said that, desk top computer assisted learning is not well suited to skill-oriented training, the key is recognising the limitations of such tools when using them for training and assessment for competency purposes. These limitations have an impact on the effectiveness of the training. Brown (1993) envisages the worst case scenario as being the one in which a client who has purchased a low cost package that does not meet the training need. He contends that this could lead to a situation in which an overconfident crew undertakes a mission exceeding their actual level of competence (under-trained and overconfident crew). In these cases CAL may be used for the theoretical and mental-skill aspects of the training prior to or in concert with "hands-on" skill training. The exception in this case is when the job is normally performed at a computer terminal, or when the terminal can reasonably serve as a simulator of the equipment used on the job. As is the case in cargo handling on board the ship where most of the calculations are performed on a computer

The increased use of electronic displays and consoles on the job, combined with programmable touch-screen displays of digitised video in computer assisted learning, have enabled more "desk top" type than ever before e.g. radar displays.

Simulations, however, are not a replacement for the real thing. Although most of the variables can be programmed into a computer, not all circumstances can be taken into account.

2.4.2.5 Expert Systems

Some tutorial and simulation software include what is called as an expert system. Expert systems are computer based tools that are designed to function as intelligent aids to decision making in all sorts of tasks. They involved from research in artificial intelligence (AI). Artificial intelligence is a field of computer science that focuses on the development of both hardware innovations and programming techniques that enable machines to perform tasks that are regarded as intelligent when performed by people.

An expert system, then, is a computer program that simulates the way human expert solve problems. Like human experts, an expert system (computer program) is approached by an individual (novice) with a problem. the system quarries the individual about current status of the problem, searches its own knowledge base (stored previously) for pertinent facts and rules that reflect the knowledge of an expert, processes the information, arrives at a decision and reports the solution to the user. An expert system usually has three parts:

- the knowledge base- which is a set of rules as they are used in a particular field.
- the inference engine, it is given that name because it is able to infer new knowledge from the responses given by the user.
- an explanation module that is used to explain to the user how a particular diagnosis was reached at. It generally does this by referring to the rules.

CHAPTER THREE

3 Evaluation of CAL in a learning process.

All teaching by definition requires information transfer from the teacher to the learner. The process of transferring knowledge from a teacher to the students is one in which the student learns how the teacher thinks about how and solves problems, within the application domain, and incorporating that process into the student's own cognitive process. To accomplish this mental process, problem solving and task execution must be shared among the students and the instructor. The instructor must perceive the degree to which the knowledge has been incorporated by the students in order to proceed with effective delivery of further material. A good teacher can therefore take a subject and help make it clear to the students while a bad teacher can take the same material and make it impenetrable. A good teacher is willing to expand the effort needed to find innovative and creative ways to make complicated ideas understandable to the students and fit new ideas to the students. In a nutshell for effective teaching to take place the teacher needs to have knowledge of the subject and skills to convey that knowledge. Therefore for CAL to be successfully employed in a learning process it should among other things have qualities of a good teacher. The question to be asked therefore is that what inherent qualities of CAL make it worthwhile to be used in a learning process.

3.1 Advantages of CAL

There are many advantages of using computers in teaching and learning. However, there are also limitations. Similar to other instructional media, CAL has its strength and weaknesses. The success of using CAL resides in how the advantages of the technology can best be used. Studies have shown that there are significant advantages to be gained by using CAL. These are:

(a) Learning can be directed to individual needs, levels and capabilities. Traditional instruction produces the characteristic curve of outcome with few participants mastering the content and many others failing to acquire the expected knowledge and skill . In most cases the students are forced to move lockstep regardless of their ability.

(b)Unlike tradition mass instruction computer based training is self -pacing through common software. This individualised instruction implies adaptation of instructions to individual difference in learning style , preferences, attitudes and intentions . It gives advice on one-on-one basis. It also allows learning flexibility thereby allowing each student to progress at his or her own pace. Teaching at different levels of ability, background and interest has posed an eternal dilemma to teachers. Instruction that is appropriate and beneficial for one student may have negative effect on another. teachers with a classroom of students know it is impractical to try to tailor lessons to teach each student. Personal attention, however would be immensely helpful because of the varied needs of pupils. Some students require additional explanations, while others grasped the materials and are ready to go on.

(c)Teaching usually progresses at the average level of the class. Poorer students are left hanging in their confusion and the brightest students missing exciting challenges. With computer as tutors, the learning of one individual will never be hindered by abilities or weaknesses of others. Each student will move at his/her own pace, unaffected by the rate of learning of any other student.

(d)The use of CAL gives new possibilities for intensifying the process of co-operation between teacher and pupil. It does not make teachers unnecessary, on the contrary, it may help in binding the teacher and the pupil more tightly together, independent of their momentary temporal or spatial relations.

(e)Another reason for better results with multimedia presentations is the interaction it provides to the user. Active responding is required from each learner, any instruction that incorporates involved participation will produce greater learning gains. Interactivity means you do not learn in a vacuum. Traditional classroom instruction permits the learner to be uninvolved foster the 'I am here to be entertained' mental state found in so many lectures. Student involvement in CAL gives them a sense of control over the lesson and therefore their learning.

(f) Traditional lecture methods can be boring and monotonous while animation, graphics and sound can be used effectively for motivation.

(g)CAL ensures that the content presented to every student will be the same since is not subject to variability in skill and presentation style of the instructors. Under CAL therefore learning materials are more uniform and consistent under group learning situations.

(h)There is reduction in training time as student learning efficiency is maximised through self-paced instruction which encourages students to take the most efficient path by spending less time on areas of strength while investing in areas of weakness.

(i) Self-paced learning takes the pressure off students so that anxiety levels are reduced. This creates an atmosphere conducive to learning while eliminating the sometimes stressful atmosphere of group instruction. Unobserved and unjudged by critical audience, students can gain confidence and get up to speed on the basic skills and principles involved in their subjects before being asked to apply their newly acquired knowledge face to face contact situations. This therefore requires the instructor to allow the students to pursue interests, develop understanding and communicate findings and also to encourage them to be creative and explore their questions.

(j) To the lecturers, the use of the CAL offers the opportunity to avoid some of the mundane aspects of teaching and frees up time for better quality contact with the students. in order to appreciate how computer assisted learning impacts the workload, it is necessary to understand how the instructor spends his or her time under the conditions that prevail in the traditional classroom. The instructional work of this typical faculty member can be broken down into two major activities; instruction-related tasks and instructional management. Instructional-related tasks include course-content organisation and alignment, classroom presentations and lectures, and student advising. Course-content organisation and alignment is the work that the instructors perform prior to actual classroom instruction. First, the instructor must organise and present the course to the student in the form of a syllabus or course outline, which includes information about the course: scope, sequence, schedule and pacing. Second, the instructor must decide which topics will be covered during classroom presentations and lectures and which ones the student will be required to learn autonomously. Third, the instructor must select and/or design the exercises that the students will be asked to perform autonomously as a means for demonstrating their understanding, learning progress and ultimately mastery of the course content.

Course-content organisation and alignment to a great degree need no longer be performed by instructors in CAL classrooms. In these unique settings, the computer assisted learning lessons run according to a pre-determined scope and sequence. Of course the instructor can tailor these to meet his or her specifications for the course, but he or she need not devote such a considerable amount of time determining these details as in a traditional instructional setting.

(b) Instructor-management tasks include student performance review and feedback, and student and course record-keeping and administration.

In this case the teacher is no longer at the centre. The centre is occupied by accumulated knowledge and experience, to which students have direct access. The students learn not only by following the teaching, they learn along with the teacher and by interaction with one another. The teacher being fully engaged in the learning process has a better ground for assessment and ability to provide direction. Indeed the student are bound to learn more than the teacher knows.

The lecturer can maximise his time as an advisor and one-on-one tutor. The teacher therefore becomes a consultant, guide and facilitator as students seek answers and develop skills.

(k)One major advantage of using CAL is that it is adaptable it can be used in wide variety of educational modes. Traditional teaching can be enhanced by incorporating computer based illustration. CAL can also facilitate remote learning by providing complete learning packages that a student through a subject from introduction to assessment. The computer gives immediate and personal feedback to the student while being patient and flexible. Computers can always go back as far as necessary to ensure to ensure the student has a solid foundation on which to build. When students are unaware of their poor learning or may not know the questions to ask, the computer itself will recognise their weakness through its constant evaluation and assessments. The programs used in CAL can be designed to teach in the sense of guiding the learners towards some specified criterion of performance .

(l) CAL can be used as job aid component in that even certified workers /employees can return to the course offered on CAL, select a small section from the menu and get the information they need to do a particular job. Therefore it aids employees to do the job right, reduces wastes, increase productivity and prevents accidents.

(m)An interactive system will not move on to new material until current material is mastered. This ensures that students have strong foundations for continued learning. The process of interaction with material being studied provides a strong learning reinforcement that significantly increases content retention over time.

Theoretically, any student can ask question in to day's classes. In reality, students who are confused may not know enough to make enquiries. Even when the pupils know they need help, they are often embarrassed and do not wish to reveal their ignorance with individualised computer instruction, students can always immediately request for help if something is unclear. They can continue to show lack of understanding without fear of appearing dumb before their peers. After the request for help, the computer can help pinpoint where the flaw lies. Then it can explain again the precise part of the lesson that bears on the student weakness.

3.2 Disadvantages

Although CAL can be very efficient, effective and generally increase learners' understanding and retention of content significantly, it has some major weaknesses.

To a traditional CAL system the students are the same except for their names and which topic they have passed. These programs are programmed the same way to the students, they teach the same way all the time. A mistake in pedagogy remains as a possible source of ineffectiveness. The problem is circumnavigated if an intelligent system is used. To an intelligent system each student is known to the extent of and usually surpassing topics completed , misconceptions , deficiencies and learning styles. Which is what happens in a traditional classroom where the instructor performs the skill so that students can imitate him. The instructor observes the student, corrects errors and gives suggestions or hints. The instruction tries to understand the students' confusions in order to help the student recall the correct information. All available cues, including responses to questions, facial expressions, voice tones, past history and the teacher can determine the student understanding of the student. Computers are much more limited in the cues they use, since they can not see the student's faces or bodies.

- Davies and Crowther (1995) are concerned that students may become proficient at interacting with the computer but less able to interact with people, as students tend to be isolated from peer groups when they are working with the computer.
- The computer lacks cognitive thinking power of classroom groups and there is a risk of attending to tasks imposed by the computer that may interrupt the "flow" or mental process of the user.
- facilities are costly to buy and maintain, they are only cost-effective in situations where there are many students studying the same course and the costs can be divided across many
- The technology is constantly changing requiring reinvestment and re-training. With technology moving quickly, there is the prospect of some current computer-based systems becoming obsolete before they have realised their true potential.

Despite the arguments of whether CAL could achieve better learning outcomes, its value cannot be ignored. Basically, the effectiveness of any instructional medium largely depends on the use of an appropriate technique.(Romiszowski,1988)

3.3 How can the Benefits of CAL be enhanced and Limitations be Minimised.

One of the most important characteristics of an advanced learning environment is its ability to evaluate the knowledge acquisition and retention rate of the user, and to adapt to the student need. To provide measurable outcomes, the system should convey, reinforce and test knowledge and engage the trainee in the development of his analysis and decision-making skills. For the CAL to be looked at as providing an advanced learning environment it should provide certain basic instructional functionalities.

There are a number of events that such a system needs to support:

- evaluation of the student's understanding of each concept .
- provision to the students' of feedback concerning his/her performance during evaluation.

- assessment of the student's complete understanding of each concept.

  For the computer based training system to achieve this, it must have the following incorporated into it.

3.3.1 Testing

In any training if the instructor keeps students notified of their progress and mastery of the lesson material, the students are likely to continue learning. one way of finding out about students' progress in a learning process is the use of questions . Type of questions used are

- multiple choice
- simple numeric
- true or false
- simulations

In CAL the type of questions supported by a system are "guided by the ease of entering a response and the ability of a computer to judge the response adequately" however, in order to have meaningful results from the evaluation by using questions the type of questions formulated should be too low or too shallow. Learning is an active and constructive process whereby learners generate meaning from information by accessing and applying existing knowledge

3.3.2. Feedback

Feedback can be defined as any information which follows as a consequence of either a psychological or physiological response. It can be a cue which is visual, aural, tactile or vesicular as in a case where it is obtained through a sense of motion. It is a vital and indispensable instructional activity . Knowledge of personal success is rewarding to the student, and a well documented psychological principle says, "whatever is rewarded tends to be repeated". each activity that is rewarded will lead to another effort and the computer can ensure that this additional effort will again result in success.

Knowledge of results in its many forms may facilitate or inhibit learning to an almost infinite degree. It has been shown that for feedback to be effective it must be:

- timely
- contain useful information
- meaningful
- communicated in operational terms

In essence , feedback must be suited to the training situation, to the level of the trainee and to the trainee's performance.

In computer based training feedback given to the user depends on the type of the program being used and Yakushenko (1993) identifies the following types

- Linear type
- intrinsically controlled
- extrinsically controlled

In linear type of programme a set of pre-determined sequence of frames dictate the progress of the student, his actions during the learning process do not affect the frames movement sequence. Student answer in such case are not taken into account.

In the intrinsically controlled programmes student progression to the next step is resolved by noting the answer given to the previous frames. The answer determines advancement or repetition.

Extrinsically controlled programmes look at the overall pre-history of the students' answers through an extrinsically control facility before a decision is made on progress of the student through each step.

Although all routines can be effective in information transfer, the extrinsically controlled programmes afford the best pedagogical capabilities, as the routine is very close to the teaching of an experienced teacher. From the foregoing it can be seen that linear programmes make no use of information on student answers. In intrinsically controlled programmes a decision is based on last step only whereas the extrinsically controlled ones make use of the overall history of the students' answers.

On the whole, immediate feedback is necessary at the outset of the program, especially at the lower level of training skill acquisition. the training benefits from correcting each deficiency and reinforcing each proficiency as it occurs. this is sometimes referred to as the developmental stage. Later on in training however, as the trainee achieves a higher level of skill and the training situation becomes more similar to the operational environment, delayed feedback is more appropriate. It will give him time to realise own mistakes before being cued and reduce the possibility of the trainee becoming dependent upon feedback in the operational environment. Therefore it is necessary that extensive reinforcement be provided during early stages of training and progressively leaner ratios as the trainees become more efficient.

3.3.3 Tracking

Tracking entails remembering where the student has travelled within the lesson and recording the student's performance . Tracking also makes it possible for participants to be able to: succeed and realise the successes, resume learning when appropriate without losing their place within the program, practise newly established skills, and, monitor their own progress throughout the training.

In most systems with a tracking element, gaining recognition for success is controlled by the system. By recording a participant's movement through the training block, the system is able to offer reward for successes and promote the ongoing success of the participant. By tracking the lesson can provide a dynamic guidance on how best to proceed through the lesson.

When a training block has been successful completed, the system acknowledges the milestone, by congratulating the student, and by also offering the next training session to be conducted.

As the system records all movements through out the session, it allows the instructor to monitor the student's performance and progress.

3.3.4 Cost effectiveness of CAL

As has been pointed out in the foregoing discussion, CAL does offer advantages over other medium in education and training. Davis(1997) argues that however, the profitability of using CAL depends on various factors. One of these factors is whether there is advantage in terms of cost effectiveness in using computer. In the first instance he invites the reader to assume that the effectiveness of both CAL and other teaching methods are similar. In such circumstances the total cost of development and delivery become significant in determining the viability of using CAL to provide learning experience. This is the case because the development costs of CAL are relatively higher than conventional teaching methods since CAL development involves extra investment and efforts. The writer agrees with him on this point as CAL material design is labour intensive and time consuming task. It can take several hundred man-hours to produce a single hour of quality of quality CAL materials. However, the delivery costs using CAL are lower since the costs of human delivery are likely more costly. He concludes by saying that the total cost of developing and delivering in both CAL and conventional teaching methods will become similar if materials can be used for certain time by a number of students. At this point and beyond, the costs of using CAL will become lower than conventional teaching methods. In the maritime field however this will take a long time to come into effect for the following reasons. Firstly, the population of maritime CAL users is still very relatively small. Consequently, the unit cost of any high-quality CAL program is likely to be high. Secondly, many of the CAL packages available are off-the-shelf type which may not necessarily met the needs of the institutions. Having programmes tailor made to suit the needs of the given institutions would require additional investment.

It has been highlighted by a number of writers on the subject that instructional programmes require updates from time to time. Since the costs of updating a CAL programme are likely to be higher than conventional methods, the number of students and the time needed to make the break-even will be longer.

The frequency of programme revisions or updates can be a significant factor in determining whether the uses of CAL are advantageous. If a set of learning materials is likely to be changed very often, it may render the uses of CAL non-beneficial in terms of cost effectiveness.

3.4 The use of Computer Based Training in Meeting STCW'95 Requirements

The revised STCW'95 convention now places more emphasis on skill acquisition and demonstration of the ability to perform tasks, and the development of new regulations and codes A and B was taken with the purpose of giving full effect to such principles. The convention contains functional requirements and criteria for competencies for ship officers and to some extent also for ratings and personnel with special duties on passenger vessels.

The convention requires that simulators are used in training and as a method of demonstrating competence. The rules specify the requirements for the performance standards of the simulators.

For institutions considering using simulators to comply with the above, use of supporting part-tasking training devices will have to be recognised. The use of these part-task devices as an integral part of the training process will make the use of these simulators to be done effectively considering that simulator time is expensive especially where large numbers of students are involved.

3.5 Technology and Distance Education

Much of the learning and training process currently takes place ashore in the maritime educational institutions, where performance can more readily observed, however, it is onboard in the ship's environment that the most effective learning and skilling relating to operations of the ship takes place.

The advent of computers for operational needs opens avenues for learning and skill acquisition. The growing availability of distance education programs supported by computer software to overcome the lack of access to education and training by mariners provides the industry with another option with which to pursue the goals of improved quality and standards of training.

The ability to handle practical tasks and problems can be demonstrated on board. Muirheard (1994) argues that recent development in the PC based simulation field have clearly shown that effective training and assessment of mariners need not be totally confined to large simulators ashore. Computer technology is capable of high levels of fidelity and effectiveness at the PC simulation level aided by enormous increase in PC computing power, memory, speed and colour graphics. CAL technology has enabled companies such as Poseidon and Maritime Education AB to develop systems to meet the urgent training demand for GMDSS communications operators. There is no reason why such training cannot be carried out on the ship and individuals monitored for standards. Monitoring of student progress using distance education can be carried out using the opportunities offered by satellite communication. This would greatly improve the training qualities on board ships. Currently, checks on the standard of training onboard may made months or years after completion of the tasks. In such circumstances verification is difficult because often the supervising master has left the ship. Muirhead further proposes that to overcome this one approach is provide check templates of trainee performance of group tasks and skills. These can be transmitted from the ship at regular intervals via Inmarsat terminals to the moderating body ashore. The most viable approach is to make use of data compression techniques utilising computer based software, a computer terminal, modem and the Inmarsat system (A,B,C, or M).The technicalities of how this is actually done has been left out as it is outside the scope of this paper. Suffice to say that using this system, advice on short comings and deficiencies can be provided to the trainee onboard from ashore very rapidly, particularly where dedicated training time is not being provided. As has been pointed out elsewhere in this paper, the impact of reduced manning on high technology ships means that the use of direct contact between trainee and tutor based would assist the ships' officers in monitoring both progress and the quality control of programs.

The immediate benefit to the maritime community is the greatly reduced cost of such programs and training, and the ability to transfer many training aspects back to the shipboard environment.

CHAPTER FOUR

4 Implementation of CAL

All too often, when new technology is introduced, it is a solution looking for a problem. Goodman (1994) asserts that technology is often promoted as the solution for improving learning before teaching and learning needs are even identified. To be justifiable, it must be a cost effective way of solving the training need. Often traditional technologies may be a better answer. New educational technology does not bring any new radical solutions to the old problems or does not decrease the necessity of co-operation between the teacher and pupils. For it to be effectively utilised in education and training, there must be an identified and specialised training need and the problems in delivering that training properly identified and analysed, with clearly set objectives and the best methods for achieving those objectives identified and used. The outcome of the project must be generic. There is little point in producing a solution to a training problem that can not be generalised for the validity of such solutions are often questioned.

All the above call for careful planning. Cradler (1994) states the planning is a critical element for successful implementation of technology in an educational situation. He points out that the plans should ;

- be guided by educational and training needs of the learner
- incorporate technology applications and practices that have been tested for their educational objectives.
- specify clear objectives related to specific educational goals.

Technology use planning should be part of existing institutional planning procedures. This will help to ensure that technology will become integrated into the existing educational program. Technologies are short lived if they are not integral with the overall institutional program. This suggests that educators should update the overall institutional plan to describe the use and co-ordination of existing as well as planned technologies to support or expand the educational objectives of the plan.

In addition to the institution's objectives and activities, the plan should also describe activities planned for each classroom. It has been observed that planning is the most effective when it is extend to the classroom and describes what teachers have to do to implement their part of the plan. Linking planning to the classroom level ensures that teachers will have a clear vision of what they will do to implement their part of the institution technology implementation plan.

The classroom planning steps address the following;

- student needs and related instructional priorities and needs.
- classroom -specific instructional activities to meet the needs
- technology based applications to support the instructional needs
- individualised staff development for the teacher
- classroom-specific performance-based assessment methods
- hardware, connectivity, software and other resources needed.

classroom planning therefore leads to;

- increased teacher commitment
- sustained increased levels of technology use
- improved co-ordination of resources for the project
- focused resources on the educational needs of students
- teachers being able to determine what technology to implement
- provides a way for teachers to communicate about the project to other staff members. (QA)

When systematic planning has been carried out, it is generally found that it provides;

- a rationale for technology and related resources
- a way to promote thinking about the most effective uses of technology

- assurance that the technology applications are aligned with the curriculum.
- help in determining the specific training and assessment needs
- assurance that the existing resources are used in the plan
- a need vehicle for producing funding
- a method for determining how to evaluate the impact and progress of the technology
- a vehicle for communicating steps for others to follow when adapting the plan
- a process for co-ordination with other programs and projects
- acts as a guideline and a context for insertion of new technologies.
- ensures at least that the teaching addresses the needs of the student

4.1 General Considerations when Implementing Computer Assisted Learning

- Teachers must have a reason to use computers. Therefore it is necessary to promote teacher development of projects or plans where teachers can apply computer assisted learning to meet particular instructional and students needs identified within such plans.
- Curricula must drive technology and technology should not dictate curricula
- Checkout what other institutions have done in the field you are trying to embark on. A lot of time and money can be saved by learning from the successes and failures. These should be married with your own institution's situation.

- Materials and hardware that do not fit with the curriculum and technology plans should both be accepted
- Training teachers is critical and on going. Teachers are more effective after receiving extensive training in the integration of technology into curriculum. Teacher preparation programs must provide the incentive, time and support systems for teachers to realise the benefit of technology and feel comfortable with utilising it in classroom. Traditionally staff development training in technology use involves a day's instruction, including hands-on experience with the software. Most of this training ignores the developmental process of adults which is the need to understand relationships, reinforce concepts with frequent use, to explore and be challenged and to conceptualise an entirely different teaching methodology. Therefore, time and money should be set aside for formal training classes as well as opportunities for teachers to discuss problems and discoveries with other colleges.
- Technology planning is a never ending endeavour. The plan must change as the project is implemented, as technology grows, and as the institution grows.
- Administrative support and involvement is critical to successful integration of technology.

In colleges where the aforementioned considerations have been taken into account, it is seen that a policy is in place concerning the purchasing of resources. The resources are integrated and compatible. There is a rolling replacement programme to ensure that equipment is up to date. Specialist equipment is available where required by curriculum areas. Teaching staff are involved in decisions about what resources are provided. The following statements will tend to be true:

- Hardware and software is seen by all staff as a common resource for the college.
- Purchasing strategy is in place to maximise the effectiveness of each purchasing decision.
- Provision is made for identifying and replacing outdated hardware and software. Replacement is timed to cause minimum disruption to student and staff.
- The level of resourcing is adequate for planned student numbers. This includes the number and quality of peripherals such printers as well as computer workstations.
- A computer network is in place. It is configured appropriately for speed and ease of use.
- Equipment and software resourcing is provided as part of an overall strategy that includes staff development, accommodation and technical support The resourcing strategy is not static,. Resources are provided as part of an ongoing process which includes planning for the future provision.

4.2 Execution.

There are five stages in the implementation process;

- Awareness

  This is the stage when staff members in the institution hear about the software in conferences, publicity material or through journal articles.
- Analysis

  During this stage staff members spend an appreciable amount of time , reading about the software, talking to users, examining the software, and discussing the possible ways to use it and how to assess its usefulness.

- Accommodation

  At this stage members of staff begin to use the software with little or no change in what they do by way of teaching. The software is seen as an "add on".

- Assimilation

  This is the stage, members begin to realise that what they do by the way of teaching could be changed, and should change, in order to enhance the benefits of using technology. Also, they recognise that the institutional support is required to alter some of the traditional practices in order to more fully integrate technology with teaching and learning.

- Adoption

  The interactive nature of accommodation and assimilation cycle does permit staff members to take steps small enough to insure their personal success and comfort while they refine their implementations. The accommodation-assimilation cycle represents the integration of technology with teaching and learning. Therefore in the adoption stage the use of technology becomes operational.

4.3 Selection of Software

Traditionally, classroom resources have been printed materials like textbooks, library books, newsprint and magazines among others. These are selected judiciously. the criteria for their selection is clearly defined. It is therefore indeed important that the same routine be followed in the selection of software to be used in computer assisted learning. Training software is becoming increasingly affordable and there is a wide variety of it on the market. The bad news is that the training software available is of varying levels of quality. the big question is how to choose a piece of training software that is right for your particular situation. Choosing almost any software remotely touching on the subjects being taught can be disappointing when the software arrives.

Parry (1988) contends that a great deal of software funding can be wasted by hasty selection, poor evaluation processes or simply by staff being attracted by the aesthetics of a program. Therefore careful consideration should be done in order to choose software that will enhance the teaching, learning and optimise the acquisition of knowledge, understanding and skills. Below are some steps that can be followed to achieve this;

- needs analysis

  The responsible teacher should first create a need analysis before jumping in head first into buying software. The first thing to determine is whether or not the computer is the appropriate medium to use to satisfy particular instructional goals and objectives. There is always a possibility that a careful need's analysis will result in a decision into the use of some other teaching-learning strategy.

  It is imperative that the input of key staff members is sought and prioritised.

- specification requirements

  If it has been identified that the use of software an instructional medium is the best way to go, then some factors need to be specified in terms of the requirements for the software :

- price

  Tight budgets are everywhere these days . Some software may be good but may be overpriced particular when compared to others that offer excellent value to do the same job.

- learnability

It is not prudent to bother with software which is difficult to use. A characteristic of a good software is that which is good to learn, easy to use and works well.

- documentation

  Good software without documentation is frustrating. the manual should be able to help the user, therefore the software should have adequate documentation . It is helpful to check whether multiple manuals are provided with the site licence.

- site license availability

  Institutions need the same software for multiple users, such as users in a class. It is possible to obtain some software products at a preferential cost when there are multiple users. It is also helpful to find out if the site licence is an annual cost or one-time cost.

- technical support and upgradability

  A good software product is a work in progress. What is the policy of the manufacturer for upgrades? Is it reasonable to expect that the manufacturer cannot continue to provide free phone support for your problems as the customer base continue to increase.

- compatibility

  It is clever to think about how well the software integrated with other software products that you may have or need and of course compatibility with hardware.

4.4 Principles of Quality Software

The best software that can be used in a learning/teaching situation is that which meets the instructional objectives. Instructional objectives can only be met if the software and the intent of the lesson are closely related. The software can be effective if it meets the following:

- It must stimulate a high degree of interest in the learner therefore the software must contain interesting cases and tell them when and only when they relate to students' problems.
- It must contribute to the development of learning and therefore increase its permanence. Students must be in control of the education process. Software may recommend what path to take, but students should always be able to stray from it to pursue their own interests. Students must be able to navigate to answers. Software that instructs but does not let students ask questions removes control from the student's hands. students should be able to ask questions of the educational software they are using and expect reasonable replies. often, however, students do not know what to ask. in this case, it should be possible for the students to navigate through an information base so as to easily discover what is there.
- It must be based on concrete experience to enhance understanding. Above all the learning should be centred on a task. The task should require those skills or knowledge which needs to be taught. It should be challenging, but within the student's ability.
- It must have optimum use of visual and where appropriate, the sensory channels to strengthen the reality of the experience.
- It should present problems and instructions. Student respond best to instruction when they see how what they are told relates to problems within which they are struggling. Instruction must clearly and directly address the needs of students.
- The software should provide a safe place to fail. Reality is not always the best teacher. In some situations, it is unrealistic or dangerous to allow novices to practise in real situations.

Computers can offer novices realistic simulations that provide a safe environment in which to make and learn from mistakes.

- Teachers want to know how much their students have learned. As long as the program can monitor what the student has been doing, no test is necessary. Instead, software can be thought of as having various levels of achievement and various gates that have to be opened to get to the next level. In order to reach a given level, the student must have been able to do tasks leading to that level. No explicit tests need ever be given if the software has been correctly designed.
- Find the fun. Learning should be fun. An instructional designer's single most important job is to make learning fun. No matter how well educational software is designed, if it is not fun, it will not work well.

4.5 The Process of Identifying Promising Software

- The first thing to do is assemble a list of prospective software vendors. This list can be put together by asking colleagues, attending seminars, trade shows and reading magazines.
- The second thing to do is to call each vendor on the list to request information and literature on their products and services.
- Assemble members of staff to compare features and benefits to the institutions needs analysis. Particularly attention should be paid to the provision of local services, such as training, implementation and technical support. the more precise the specification of requirements, the easier it will be to screen out those products that are least likely to meet the user's specification and the easier it will be to focus on more promising products.

- relevant reviews

  Reviews are important screening tools when used as part of the entire process of selection. A software program may have received a poor review because it was tested with a different audience than the one you have in mind.

- preview software

  "try before you buy"- The process of selecting software is often not simple for teachers who have recently embarked on using computers in their classroom. Ideally, the best procedure to use in evaluating an educational software program is actually take the program into the classroom and let students try it out and see how the students interact with the program. In this way you are able to make concrete decisions on the suitability of the program and ultimately, whether to purchase the program for your students. However, it is not always possible to obtain software titles from publishers for preview purposes only. Also, it is not fiscally wise to purchase software titles merely for the purpose of evaluating them.

CHAPTER FIVE

5 Analysis

In the implementation of CAL in MET lecturers will be faced with software choices. In all categories of resources that are available for the classroom, there is a wide variety of qualities; some are excellent and some are absolutely terrible . There is therefore a need that the lectures intending to use CAL to be prepared to systematically examine computer software, as they would with a book or film before using it for student.

In cases where it is possible to acquire software for review, it would be advantageous to pay attention to the following aspects of the software;

- How well does the product mirror the primary goal for the training desired?
- Can the product be delivered within the confines of our existing system?
  - (a) from a hardware standpoint?
  - (b) from a facilities stand point?
  - (c) within the confines of the available schedule
- Does the program facilitate student learning? e.g., is the content relevant, accurate, and presented clearly and logically ?
- Is the program ease to use ? i.e., look at features that make the program user-friendly e.g., efficient use of menus, input format, input formats (keyboard or mouse or joystick, touch screen)
- is the program interactive ?i.e., does it engage students?, are the students in control?

look at the motivational aspects of the program. does it capture and maintain students' attention?, does it provide challenge, choice, and curiosity to students?

5.1 Evaluation Form

One of the ways used in the evaluation of educational software is to devise a form that would help in the evaluation. The form is made in such a way that it is easy to use for different software programs.

(this form is based on a similar one created by Dr. Jim Kerr http://www.ed.brocku.ca/~jkerr/sftwreva.htm)

EDUCATIONAL SOFTWARE EVALUATION.

title company address	price site licence Notes
type of computer	peripherals:
Subject area frequency of use	Delivery methods: lessons/tutorial drill simulation testing other

For each of the criteria below, determine if the program is excellent, good, fair or poor. Place a mark in the correct column by each item.

educational content	**excellent**	**good**	**fair**	**poor**
the program is appropriate for classroom setting				
the program content fits with current curriculum, and is accurate				
help is available				
criteria for advancing can be adjusted by the teacher				
follows progression of skills				
branches to new information and reviews old information and adjusts feedback				
the program provides clear and concise learning objectives or learning objectives are explicit				
the content, examples, and illustrations used are appropriate for the target group				
the program utilises sound instructional strategies, and content representation is logical and clear				
the program accomplishes stated objectives				

ease-of-use	excellent	good	fair	poor
using the program does not require extensive computer knowledge				
the program allows for varied input formats e.g., use of keyboard, mouse etc.				
instructions can be bypassed				
clear, complete student documentation				
clear, complete teacher documentation				
the program is easy to load				
saving and re-running functions easy to accomplish				

interactivity	excellent	good	fair	poor
the program engages students actively learner's actions: challenging... appropriate... valuable..				
the program provides useful feed back based on students' actions				
the program utilises interactive capabilities of the computer effectively				

motivational aspects	excellent	good	fair	poor
the program captures and maintains student's attention				
the program provides students with choice, challenge, and curiosity				

presentation	excellent	good	fair	poor
the screen displays are clear and nicely formatted, i.e. no overcrowded and clutter screens; no unfamiliar abbreviations, codes or icons				
Clear what options are available				
the program uses transitions and visual effects appropriately				
the program uses appropriately text, colour, graphics sound animation video				

5.2 Data Collection Methods

For the form to be filled out correctly, there is a need to collect the information systematically. Some of the methods which can be used in the collection of information are as follows:

5.2.1 Observation

For some programs the best information about what students are learning comes from their discussion as they use it. This is qualitative data requiring careful analysis. It is best collected by the observer taking notes on a prepared Observation Schedule, backed up by audio-recording.

In addition some programs will only reveal their impact in discussion that happens in some follow up activity, like a debriefing session, or team-work based on the detailed computer based session. Again field notes backed up by audio recording are best. This session has to follow soon after the computer session if there is not to be interference from other learning sessions.

The most effective way to produce useful formative evaluation data is watching students working their way through a program. the way the students work, what they do with the program, whether they spend time in discussion, writing notes, consulting information, attending to the right parts of the program, using it to the best advantage are all best judged by observing what they do.

Watching pairs of students is usually better than individuals alone because pairs talk to each other, and the discussion allows the evaluator to hear how they are thinking about the program. Students actions on the learning tasks in the program are highly observable, so interactive multimedia is an unusually good environment in which to observe learning performance. Recording on an Observation Schedule, against time, program response and discussion data gives a very complete account of student use.

5.2.2 Monitoring

Where student's work is so open-ended that even a general form of on-line test is not possible, then the best test of the pedagogical value of the program will be to monitor the way the student uses it, to see if the resources (a) make a significant contribution (b) it is used in the appropriate context.

5.2.3 On-line test

Where a post exercise test is in appropriate e.g. if initial knowledge states are too variable, and end -states are unpredictable, then it is only possible to test in terms of what student has actually done during the session

5.2.4 Interview

The main point of an interview is to elicit the participant's point of view. Unstructured interviews are conducted at the stage where the evaluator is uncertain of what the key issues might be for the teachers and students. The type of questions used in such a case are, ' can you tell me about your experience of learning with X'; 'Are there ways it could be improved'; 'what was good about it'.

A structured interview will derive the questions to be asked from the objectives of the program, the evaluator asks more detailed questions so that they can fully understand the participant's point of view.

5.2.5 Teaching Context

Information about the way the program is used is also more extensive in the summative phase, where a variety of contextual conditions will appear. The way students are introduced to a program, the preparation they do, the support they get while using it, the amount, type and timing of follow-up work, the final assessment attached to it, the amount of usage, whether it replaces other teaching and many more are crucial for its perceived and actual value. This information is best obtained by Observation Schedule and Teacher's Questionnair

Questionnaire to each teacher who has used the product, should cover the following:

- how exactly they used it,
- their experience of using it overall,
- comparative value,
- amount of teaching time (range) per student it offers,
- whether it could produce savings in student learning time,
- whether it could produce savings in staff teaching time,
- whether it could produce savings in other resources,
- to what extent the time spent on it is worth while,
- what further support or improvements developers should be offering.

5.3 Analysis and evaluation of some software programs

5.3.1 Officer of the Watch

System description

It is a PC based software for training in collision avoidance and watchkeeping procedures. It consists of two programs: the Officer of the Watch 'simulator'for the students to run exercises and the Officer of the Watch Course Designerfor instructors to create exercises. It is available to run on stand-alone PCs or for multi-user Novell netware. It contains 13 vessel types namely;

Frigate	Container vessel	Fishing vessel
Tug (with tow)	Motor Cruiser Ferry	Mine hunter
Pilot boat	Hovercraft	VLCC
Coaster	Lifeboat	Yacht

Ownship and target ship can be a combination of any of the vessel types mentioned above. During an exercise a student can choose to look ahead, astern, port or starboard. the view shows land, navigation marks and traffic by day, vessel lights and navigational marks by night while at dawn and dusk vessels appear as silhouette with lights showing.(appendix one)

Features available on the menu which is displayed include the following; telegraph, automatic or manual steering, speed log, heading repeater, rudder angle indicator, clock and stopwatch, and whistle. there is also radar view with standard controls and electronic chart for the area where the exercise is being done. The student can also use binoculars and bearing compass.

The instructor can specify constraints for any vessel which will then exhibit the appropriate lights and shapes.

Officer of the watch contains dialogue inputs multi-choice questions, and an expert system. Messages can be interjected into the lessons to state objectives, give directions or provide summaries. The questions cover;

- Rule of the Road
- Identification of navigation aids
- Principles of IALA A and B
- Identification of aspect
- Sound signals

The expert system contains a knowledge base of the International Regulations for Prevention of Collisions at Sea. It monitors the actions of all vessels and allows target vessels to be directed so as to obey the Rules.

It has bridge log, question and answer log, a full log which records all events which occur during the exercise and a profile log which provides an analysis of the percentage of time spent in each area of activity during the exercise.(appendix two)

5.3.2 Analysis of officer of the watch

It integrates in a single package facilities that can run simulation exercises from basic level to complex level. It can therefore be used for in providing progressive training as it starts from ground up. The software also allows for exercises to be graded so that for foundation work student's attention is focused on part tasks with the expert system giving guidance and reinforcement. As students knowledge grows, assistance is gradually phased out, the exercises become more complex and the student is given more freedom to use his skills.

The keeping of records of actions taken by the student during the exercise enables the instructor to quickly review the student's watchkeeping practices and assess the students progress.

The play back system provides a forum for debate and debriefing and can also be used in the teaching mode to illustrate points by projection on to a screen.

the built-in control expert system allows the instructor to create interactive lessons where the exercise's outcome depends on the student's action during the exercises. the instructor can also deny access to any of the elements or tools of the simulation. In a teaching mode this can be used to develop in students particular skills e.g. radar plotting . It also provides a facility to introduce new targets in position relative to whatever ownship's positions might be any time. You can therefore create the desired crossing situations without worrying about the actual position or course of the own ship.

The system is ease to use in the sense its user-interface is icon-based. This makes it possible for a user with limited computer experience not distracted or delayed in attending to the application of the system.

The system allows trainees to discover principles and concepts by themselves and learn from their mistakes but on the other hand, the trainees attention can be directed and controlled where appropriate to avoid lessons degenerating into play.

The system also contains comprehensive debriefing, playback and review facilities. On the whole the system can be used to train trainees carry out part tasks which can include, among others, the following:

- maintaining a proper look out by radar
- determine close quarter situations
- Application of the Rules of the Road
- The benefits of safe speed

5.4 Navi-trainer

It is a PC-based which can be used for training ships' officers to improve their proffesional navigation and ship-handling skills. The visual mode produces a computer-generated, 3-D view of the sky and the sea by day and night and also weather and vibility effects. Floating or coastal objects can also be seen. The binoculars function with magnification. (appendix two: fig 4)

The system uses a video plotter display based on ECDIS format. The display gives all relevant information from the track and waypoint data entered for the exercise. (appendix four) On completion of an exercise, the analysis will provide a play back of the scenario, this is given in the form of print out of the exercise area. (appendix three fig. 5)

The system also provides an eduactional menu which contains International Signals as well as Rules of the Road.

The system also provides customised training equipment for ship handling simulation, marine radar simulation, passage planning and basic training. It can be used for training as well as assessment.

CHAPTER SIX

6 CONCLUSION

This paper concentrates on the application and use of computer assisted learning in the maritime training and education. Maritime education and training is facing major demands on the way that it is delivered in the various institutions around the world. There has been a general outcry that there is a serious gap between the nature of training afforded to the trainees in the institutions and skills required by the industry. The revised STCW'95 is aimed at addressing this shortfall.

Computer assisted learning systems can be used to help bring maritime training closer to ship board practices. Many distracters of computer assisted learning assert that maritime training hinges on skill training and gaining of competency. They contend that it can only be done effectively in the real world. This might not be entirely true as the training in maritime field covers both theoretical underpinning knowledge as well as practicals. In this respect CAL may be used for theoretical and mental-skill aspects of the training prior to or in concert with 'hands on' skill training. Furthermore, some of the skill aspect can be done using PC based part-task trainers. Whether the use of simulators or training ships is the most effective way, there is still room for computer use in maritime training. The potential of computer assisted technology in maritime education and training does not diminish the careful use of resource to achieve current purposes.

The point that should be borne in mind is that when introducing CAL the initial outlay of time, energy and money is frightening especially to institutions already strapped for resources. Institutions are asked to do more with less and to do it sooner i.e. provide high quality learning while containing the costs. Nevertheless, the return on investment in CAL is well worth the price if implemented properly.

When introducing CAL in an institution, it should not just be use of computers as a delivery system of learning materials. It implies producing learning that is more effective than before. It also entails the use of computers to development more efficient and more exciting ways of learning. What should be avoided is using this kind of technology to entrench existing teaching practices which would just be the same as automating the status quo. The focus ought to be how CAL can be applied creatively to enhance teaching and learning.

For CAL to be used effectively in maritime education and training there must be an identified training and specialised training need and the problems in delivering that training properly identified and analysed. Objectives should be clearly set and the best methods of achieving those objectives identified. The applications which are available through CAL can only be successful if the implementation is appropriate and well supervised.

Of major importance in CAL introduction in an institution is software selection and implementation. This has been described by many writers on the subject as the meeting point of success for all parties involved; hardware vendors, software publishers, instructors/lecturers, administrators and students. In the implementation it is appropriate to make sure that the resources are integrated and compatible, software selection is systematic and is done after careful evaluation.

BIBLIOGRAPHY

Alessi S.M. (1991). Computer based instruction: methods and Development. Englewood Cliffs, NJ: Prentice-hall.

Beckin Consultancy, *Software evaluation checklist*, http://www.usa.com/beck.soevch.htm

Blackburn, G W (1995). Transas marine navi-trainer senior +, Seaways, January

Brindle, C A (1992). *Practical training at sea: on board training*, The second LSM International Manning and Training Conference, Singapore, October 12-13 1992.

Brown, G (1993). *Ship simulation: Growth & development: Search for standards.* Safety at sea International, September.

Cradler, A (1994). Implementing technology in Education: Recent Findings from Research and Evaluation studies. Technology Policy Research & Planning, Information & Resources. http://www.fwl.org/techpolicy/recapproach.html.

Cross, S J (1997). Maritime Simulators and the Revised STCW, Lecture notes, World Maritime University, Malmö, Sweden.

Cross, S J (1997). Quality Assurance Systems in Maritime Education and Training (MET) Schip & Werf De Zee February

Davis C (1997). Retrofititng instructor-led training to CBT. http://www.cbtsolutions.com/396-davi.htm#ilil

Donselaar van, (1996). Computer Aided Instruction, an on Board Training Tool. MARSIM, Journal

Draper, S (1997). Niche-based success in CAL. http://www.dcs.ex.ac.uk/~cal-97/papers/draper-3.htm.

Easton, A (1996). Computer Based training. Http://www.infopt.com/infopoint/cbt.htm.

Edward N. (1997). Development of Cost effective Computer assisted learning (CAL) package to facilitate conceptual understanding. http://www.dcs.ex.ac.uk/~masould/cal-97/papers/edward-b.htm

Eldridge, J (1996). *Shipping and Aviation Compared,* Seaways, October,1996.

Eric digest (1996). Improving software selection process http://www.netc.org/software/eric-software.html.

Gibson, E J (1997). A comparative analysis of web-based testing and evaluation systems. http://renoir:csc.ncsu.edu/MRA/reports/webBased testing.html

Hannum, W (1997). Technology for instruction: Learning benefits from Multimedia http://www.sover.net/%7 eren/hannum.html

Jarvilehto, T (1997). Learning and new educational technology.
http://www.grafi.oulu.fi/lab/artikkelit/eductel.html

Joshi, S k(1997). *'Live Ware' And Simulation* Seaways, March, 1997.

Lander, D (1992). Online teaching : Educational considerations. http://homepages.eu.rmst.edu.au/resdl/teachings3.html February

Makrakis, V(1987*). Computers in Education: towards a new Pedagogy*: Institute of International education, University of Stockholm.

Meek, L (1997). An Introduction to Computer Based Instruction. http://www.cream:une.edu.au/studentspapers/lynnelM.html

Muirhead, P M (1994). Satellite Technology, Computer Aided Learning And Distance Education Methodologies; A New World Of Learning And Training Opportunities At Sea, The Eigth IMLA International Conference Of Maritime Education and Training,Oeiras, Portugal, July.

Muirhead P M (1995). *Learning Curves*, Ocean Voice, April, 1995.

Muirhead, P M. (1996) Developments in maritime education and training software: growing trends in use of the medium for assessment of knowledge and skills: Some reviews and experiences in selection and use of software by lecturers. IMLA Conference workshop Kobe, Japan September 21-22,

Olds, H.F. et al (1980) People and Computers: Who teaches who?, Educational Development Centres, Newton, MA.

Parry, A K (1988). *Competency based vocational training*. Ocean Voice, April, 1988

Reeves, T (1996). *Learning with technology: Using computers as cognitive tools*. In D.H. Jonassen (ed) Handbook of Research on Educational Communications and Technology. New York: Scholastic Press.

Romiszowski, A J (1986) Developing Auto-Instructional Materials: From Programmed text To CAL and interactive Video, London; Kogan.

Short, R F (1992). *Simulators: Evolution of Maritime education and Training into 21st Centuiry.* 2nd International Manning and Training Conference, Singapore, October.

Taylor, R P (1980). The Computer in school, Tutor,Tool, tutee, New York, Teacher College Press.

Underwood, T D (1992). *Training for Competence Afloat and Ashore: time for reappraisal*, Safety At Sea And Marine Electronics Exhibition And Conference, London , April.

Waddell, G (1982). *Simulation balancing the pros and cons.* Training and Development Journal.

Wahren, E (1992). *Application of air crew management training concept in the maritime field.* The second LSM International Manning and Training Conference, Singapore, October, 12-13

Walsh, C (1997). *Testing Times for Colleges*, The Baltic, July

Woody, W (1996). The Do's and Don'ts of technology planning. http://www.isf.com/article/htm# effective

Yakushenko, A (1993) The past and future use of computers in Maritime Education and Training. IMLA Newsletter, no 20, May, 1993.

Yousefi, H (1994). Significance of Microcomputer on Simulation Technology, Seaways September 1994

Appendix One

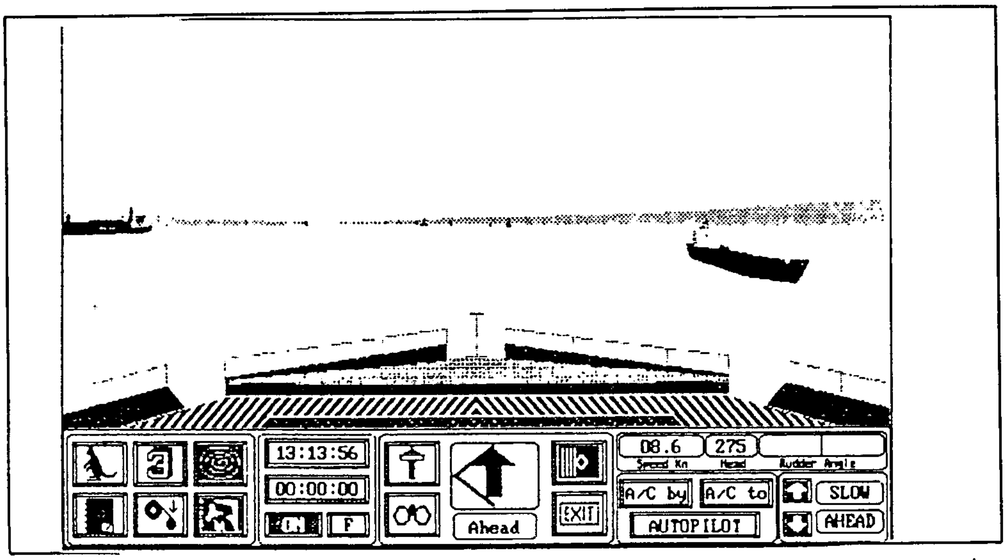

Fig 1 . Exercise in action show ing panel from where all functions and equipment can be accessed

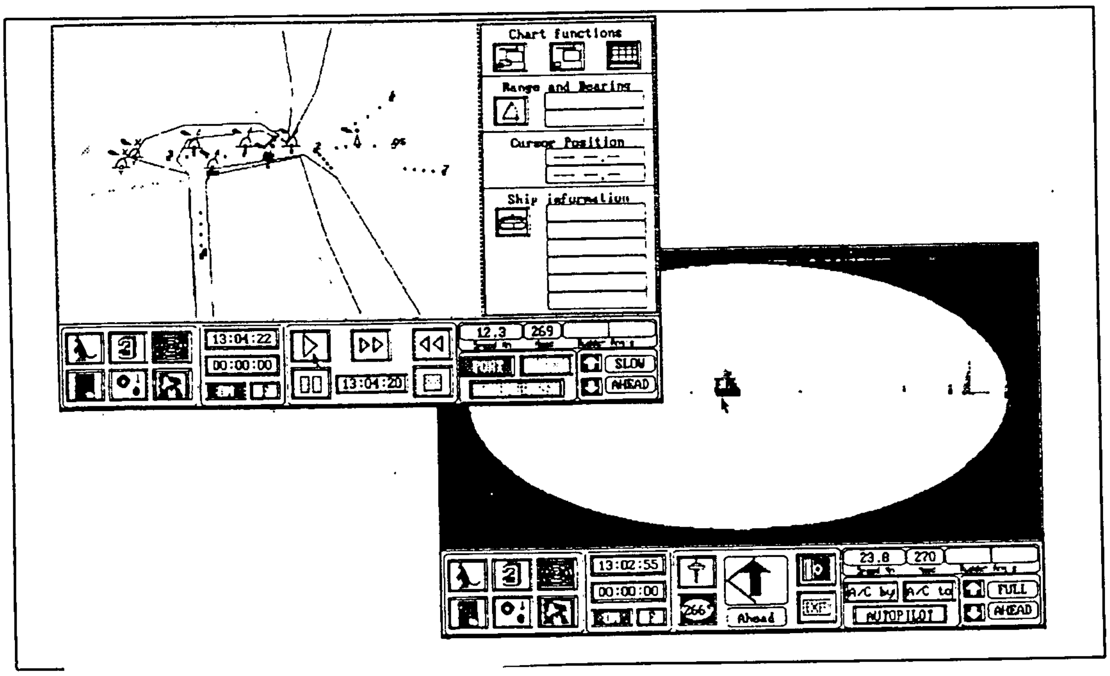

Fig 2.Exercise recorder and binoculars views in OOW

APPENDIX TWO

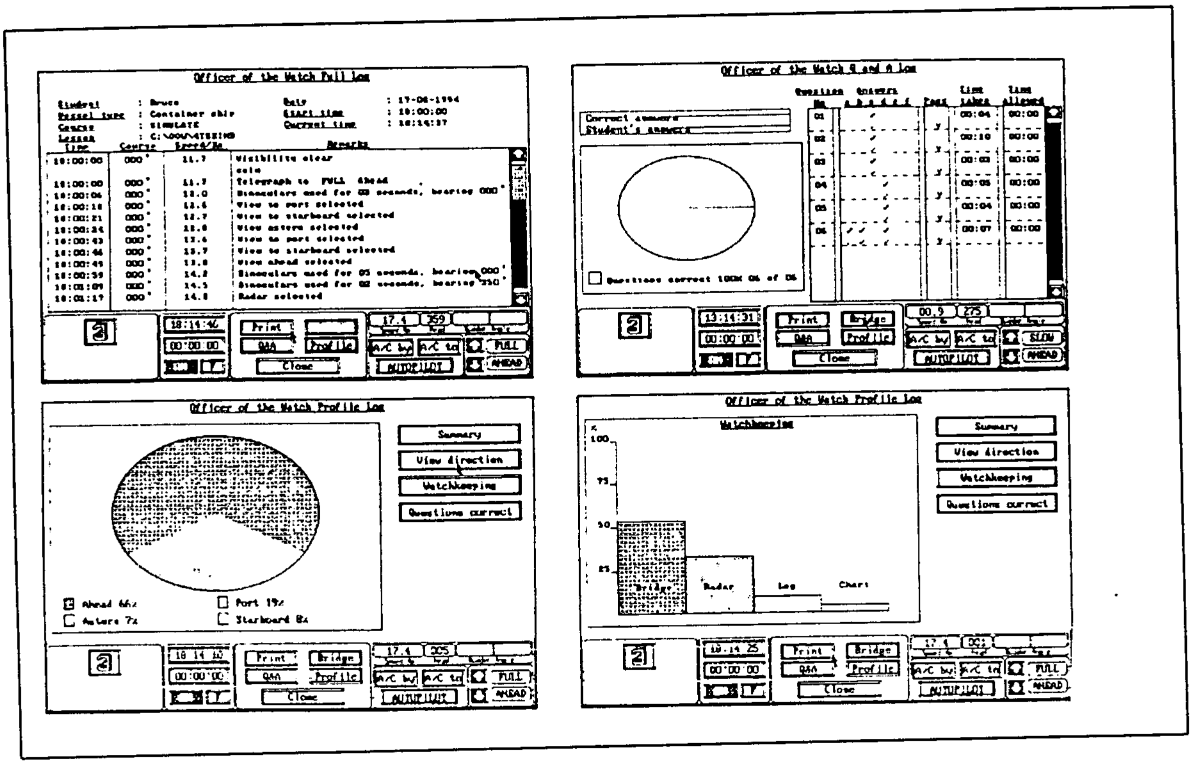

FIGURE 3: OOW FULL LOG AND QUESTION AND ANSWER LOG

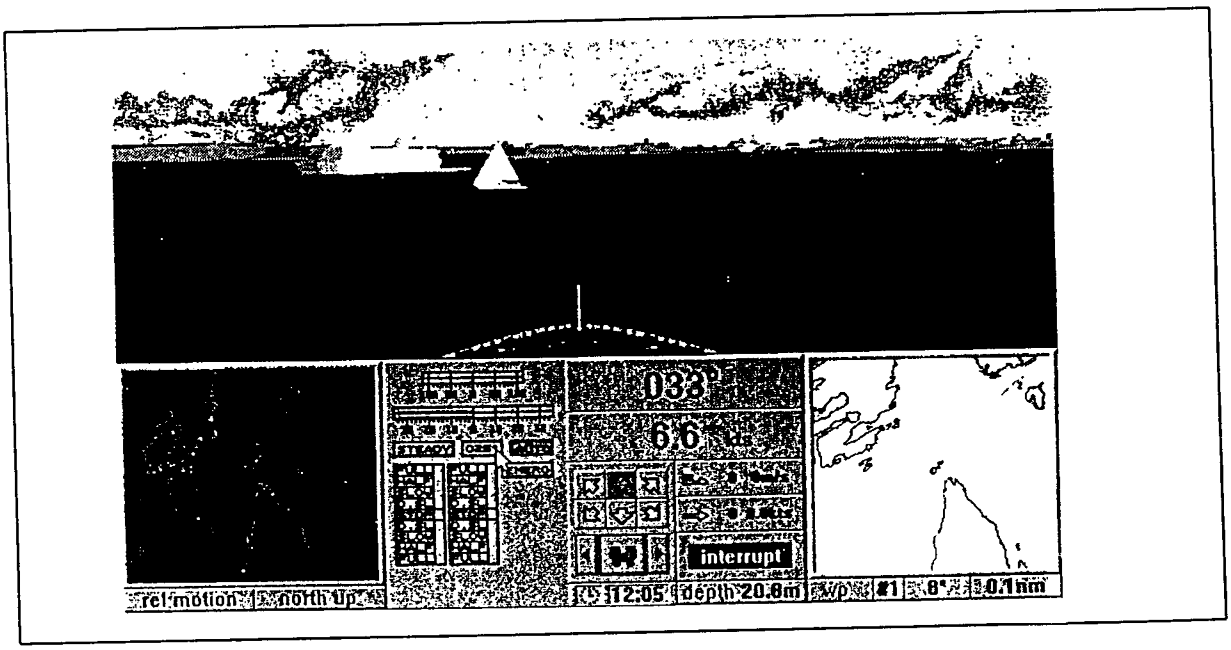

Figure 4 : NAVI-TRAINER exercise in action

APPENDIX THREE

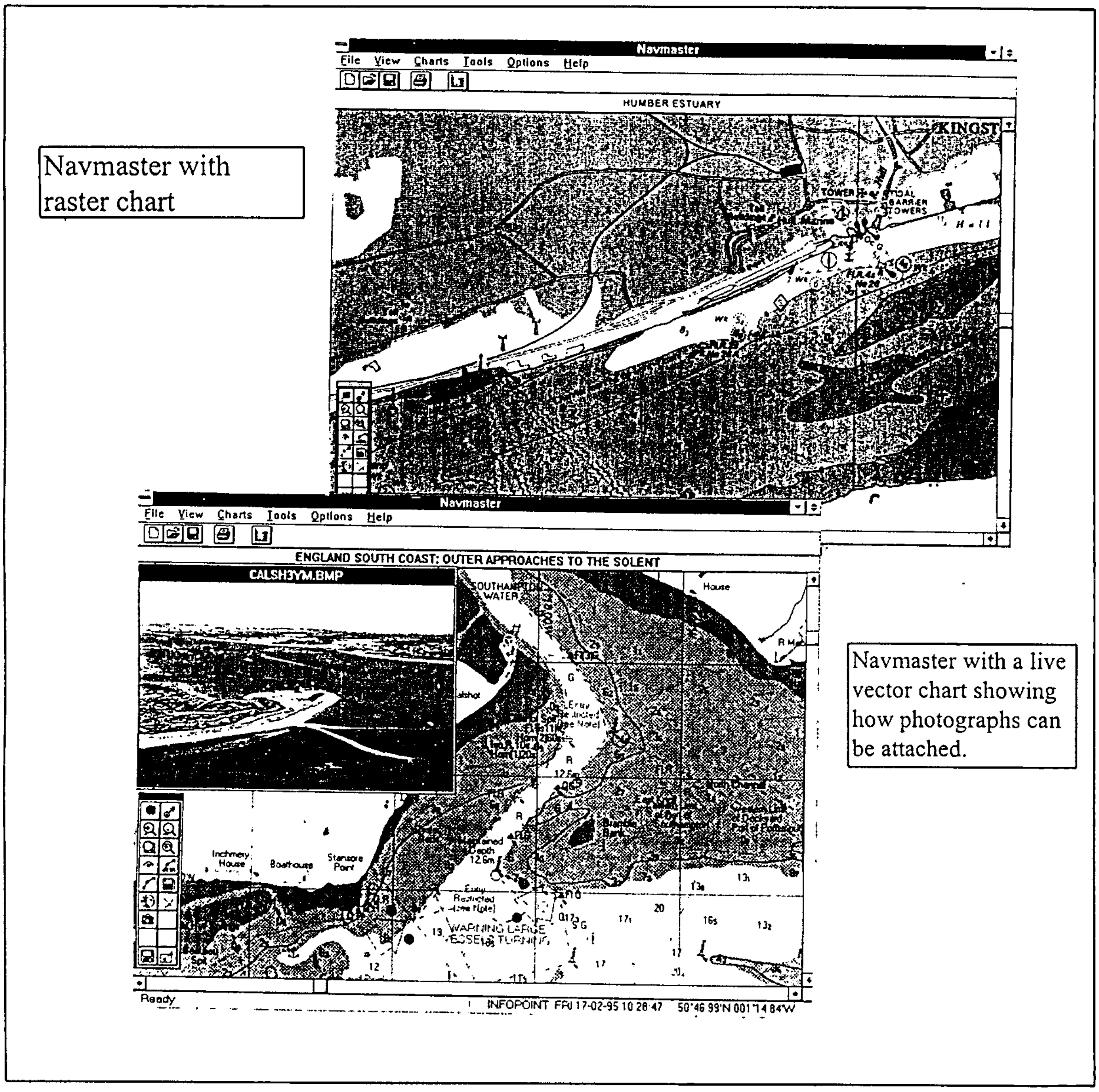

FIGURE 5: NAVI-TRAINER DISPLAY

APPENDIX FOUR

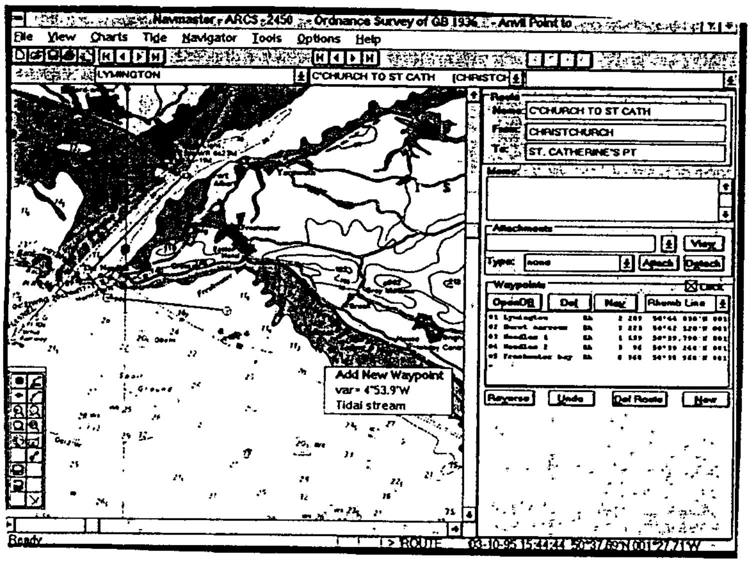

FIGURE SIX NAVMASTER : CREATING AND MODIFYING ROUTES

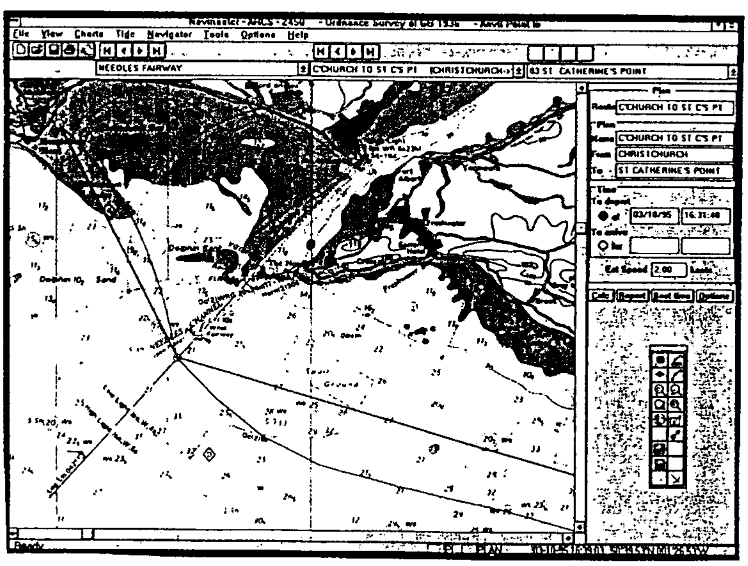

FIGURE SEVEN: ROUTE PLAN.