Computer Based Training: A global survey of current developments and its application to maritime education and training

By

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in

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(Nautical)
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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.

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ABSTRACT

Title of Dissertation: Computer based training: A global survey of current developments and their application to maritime education and training

Degree: M.Sc.

This study discusses the development and methodologies of Computer Based Training (CBT) from a global point of view, and their applications in MET institutions, and for onboard training. It also considers the impact of CBT on those involved in taking decisions in choosing the training media in MET and in shipping companies.

The approach taken is to examine the current CBT structure methodologies, and their impact in the maritime industry taking into account the requirements of the revised STCW Convention and ISM Code. The use of CBT as a learning resource and a teaching tool is examined, as well as its affect on improving students’ cognitive processes.

A comparison between traditional teaching and using CBT is investigated, with a presentation of two applications using CBT in Maritime English (ME), and a shiphandling simulation. Additionally, the role of CBT in onboard training and its potential use were collated and examined to present a clear view for the effectiveness of CBT on the performance of seafaring cadets and crewmembers.

The concluding chapter answers the questions raised by the author at the beginning of this study, and provides a summary of CBT structure methodologies.

Key words: Computer-based training (CBT), Developments, Application, Maritime Education and Training.
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<tr>
<td>ADL</td>
<td>Advanced Distributed Learning</td>
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<td>CAI</td>
<td>Computer Assisted Instruction</td>
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<td>CD</td>
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<td>CD-I</td>
<td>Interactive Compact Desk</td>
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<td>CES</td>
<td>Computer Evaluation System</td>
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<td>CMI</td>
<td>Computer Managed Instruction</td>
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<td>DMI</td>
<td>Danish Maritime Institute</td>
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<td>DVD</td>
<td>Digital Video Desk</td>
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<td>FMS</td>
<td>Full Mission Simulator</td>
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<td>FMV</td>
<td>Full Motion Video</td>
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<td>GMDSS</td>
<td>Global Maritime Distress Safety System</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<td>IBS</td>
<td>Integrated Bridge System</td>
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<td>IMLA</td>
<td>International Maritime Lecturers Association</td>
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<td>IMO</td>
<td>International Maritime Organization</td>
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<td>INS</td>
<td>Integrated Navigation System</td>
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<td>ISM</td>
<td>International Safety Management</td>
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<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>LAN</td>
<td>Local Area Network</td>
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<td>LNG</td>
<td>Liquefied Natural Gas</td>
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<td>ME</td>
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<td>MET</td>
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<td>NFU</td>
<td>Non-Follow Up</td>
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<td>Acronym</td>
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<td>OOW</td>
<td>Officer Of the Watch</td>
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<td>PCs</td>
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<td>PLATO</td>
<td>Programmed Logic for Automated Teaching Operation</td>
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<td>R&amp;D</td>
<td>Research and Development</td>
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<td>Ro/Ro</td>
<td>Roll-on / Roll-off</td>
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<td>SAR</td>
<td>Search And Rescue</td>
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<td>SMCP</td>
<td>Standard Marine Communication Phrases</td>
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<td>SMS</td>
<td>Safety Management System</td>
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<td>SOLAS</td>
<td>Safety Of Life At Sea</td>
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<td>STCW</td>
<td>Standard of Training, Certification and Watchkeeping</td>
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<td>TICCIT</td>
<td>Time-shared Interactive Computer-Controlled Information</td>
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<td></td>
<td>Television</td>
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<td>VTMIS</td>
<td>Vessel Traffic Management and Information Systems</td>
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<td>VTS</td>
<td>Vessel Traffic System</td>
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<td>WANs</td>
<td>Wide Area Networks</td>
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<td>WEMS</td>
<td>Web Education Management System</td>
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<td>WMU</td>
<td>World Maritime University</td>
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<td>WWW</td>
<td>World Wide Web</td>
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Chapter 1

Introduction

The specialized training of marine students, seafaring cadets, and crewmembers has seen numerous changes in the last few decades. Reduction in personnel and budget cutbacks have led Maritime Education and Training (MET) institutions and shipping companies to utilize new forms of technology to achieve their training objectives. Training mariners at sea no longer remains the only option. Increased demands to reduce cost have led to the development of new training methodologies. The important goal of any method or program is to ensure that quality training is achieved.

With advances in computing power over the last few years, the ability to develop and run interactive media applications has advanced tremendously. Today’s desktop and even laptop computers have the computational power, speed, and storage capacity to handle content-intensive multimedia software applications. Parallel with the gains in computing technology have also come rapid advances in training mediums available to instructors. This field of newly developed training mediums has become filled with terms: computer-based training (CBT), computer-based instruction (CBI), computer-assisted learning (CAL), online learning, multimedia instruction, and digital multimedia instruction, to name a few. Each of these terms and existing training systems put a slightly different spin on the same basic theme (Lyras, 2000).

Furthermore, advances in technology have allowed developers to create CBT applications that include the full range of multimedia content: graphics, animation sequences, high quality digital images, sound files, and video segments. CBT can be
used in many ways in the context of training; to simulate the task environment (simulation), to take over low-level or routine tasks (tools), to manage the logistics of education (Computer Managed Instruction “CMI”), to administer tests and keep the scores (Computer-based Assessment “CBA”), to facilitate educational research, and also to provide instruction and training to seafaring cadets and crewmembers (Muirhead, 1995).

In addition, the ability to combine a wide variety of multimedia content is a great advantage to increasing retention of new knowledge. Today’s multimedia capable PCs allow developers to take advantage of the fact that people, as educational research indicates, learn 20% of what they see, 40% of what they see and hear, and 70% of what they see, hear, and do (Muirhead, 2000). If that is the case, the combination of computers, networks, and multi-media capabilities is clearly a formidable educational tool. Thus, to create a complete multi-sensory learning program is to allow students to interact with the material, and to learn according to their own needs, pace, and learning styles.

Furthermore, a subset of CBT programs is based on simulations of the real world. Simulation-based programs usually have lower physical fidelity than reality (or Full Mission Simulator, “FMS”). They often provide a more abstract, functional simulation rather than mimicking the exact physical properties of the task environment. Moreover, most CBT systems are quite straightforward branching systems, the trainee being presented with some domain knowledge followed by a number of questions or exercises to make sure that he/she has understood the information presented and can apply it in different contexts or environments. The errors trainees might make are foreseen, and feedback or remediation is pre-programmed.

Moreover, most CBT programs are relatively brief, and deal with only well structured domain, because the major goal is to teach specific tasks or knowledge
efficiently. Hence, CBT systems are designed for a specific domain and a specific
group of trainees. They are often based on the knowledge of experienced lecturers in
the domain, rather than on theories of instruction. In addition, technical issues are
important; for example, CBT systems must respond rapidly, be attractive to trainees,
and run on affordable, widely available computers (Larkin & Chabay, 1992).

There are many reasons for using CBT in MET institutions such as to:
- Reduce the variability of instruction
- Reduce the requirements for the presence of instructors
- Make training available at any time to match student availability
- Provide training in remote areas where instructors are unavailable

Another factor to consider when developing and using a computer-based training
application is the dynamic content of the course material. If the course material
requires frequent updates to remain current, or student training would benefit from
frequent updates of the training material content, then computer-based training has
an advantage over written course materials. Key changes and updates can easily be
edited into CBT applications. Depending on the specific CBT utilized, developers
can then post updated applications to their course website, or distribute updated
versions of the software package. Thus, users then have immediate access to the
most current training information.

1.1 Objectives
Training technology in the form of high fidelity and real time media, would greatly
improve the way marine students, seafaring cadets, and crewmembers are trained in
the required skills of ship-operations either at MET institutions, or onboard. There
are several reasons for preferring to use one training media over another. A
particular media may be inherently more suited to training particular skills than
others, for instance, because it offers a training environment that is more valid or
because the type of instructional control that may be exercised is more suitable.
The considerations that are relevant, and the way in which they are weighted will vary substantially from case to case. In order for modern training techniques in the maritime industry to work, certain training methodologies and requirements must be addressed and proven accurately. For example, CBT in combination with multimedia can be used for familiarizing trainees with basic operating concepts and interface principles and characteristics. In addition, multimedia CBT may offer good opportunities for training many individual perceptual and cognitive skills. There are a number of methodologies (models) of CBT, shown in figure 1.1, which in practice overlap somewhat and are often used in combination.

\[\text{CBT methodologies}\]

- Drills
- Tutorial
- Simulation
- Games
- Assessment

\[\text{Figure 1.1 CBT methodologies (models)}\]

Thus, the objectives of this dissertation are:

1. To conduct a literature research into the growth and development of CBT from a global point of view.
2. To identify current developments in CBT methodologies, as they impact upon the maritime industry.
3. To evaluate the use of selected CBT applications, as to their effectiveness as learning resources.
4. To discuss the potential use of CBT methods in the onboard training environment.
1.2 Questions raised
In carrying out the research, a number of questions were posed for which answers have been sought.
1. What is CBT, and what are its methodologies today?
2. Are there differences between using CBT and traditional methods? If so, what are the challenges of CBT for teachers and students?
3. What are the potential applications of CBT in MET?
4. What are the potential uses of CBT onboard ships?

1.3 Methodology
This thesis includes a literature search of teaching methodologies in MET institutions, by examining conference proceedings, especially those conferences which are held by the International Maritime Lecturers’ Association (IMLA). Moreover, a literature search of the topic with the focus on identifying CBT methodologies as a learning tool is carried out. The Nautical Institute’s publications such as CBT @ sea 2000, CBT @ sea 2001, the Seaways periodical, and others, as well as Internet sources, are examined.

In addition, the author has made contact with the producers of CBT such as Seagull, MarineSoft, and the Danish Maritime Institute (DMI), now called “Force Technology” to collect information concerning the current developments in the methodology of CBT and the new areas which are considered as its applications either for MET institutions use, or for onboard training use. Furthermore, observation of others and discussion with professionals in teaching methods during field study trips while at WMU and the author’s own experience were also used in finding out the potential use of CBT in MET and onboard training.
1.4 Summary of chapters

The remainder of this thesis is broken down into the following chapters:

- Chapter 2 provides a brief description of the origin of CBT and its definition. Additionally, its development and structure methodologies are presented. Finally, the impact of using such programs is provided.

- Chapter 3 examines the learning resources and the use of CBT as one of them. A comparison between traditional teaching and using CBT is carried out.

- Chapter 4 discusses the use of CBT as a teaching tool and demonstrates two applications of using CBT on MET institutions and onboard.

- Chapter 5 illustrates the need for onboard training, and discusses the potential advantages and disadvantages of using these programs, with the presentation of an example of using them in onboard training.

- Chapter 6 draws the final conclusions on the topic researched within this dissertation.
Chapter 2

Overview of CBT

The use of computer-based training (CBT) has been increasing over the past few decades. In that time-span incredible advances have been made in computer technology and its availability at relatively low prices has led the educational service to encourage the use of computers in Maritime Education and Training (MET) institutions and at home. The rapid developments in programs allow interaction via text; graphics, voice and the most recent developments in microcomputer technology provide even greater power and ease of use through advanced visual and auditory devices (Alessi & Trollip, 1991).

This chapter presents a brief historical background of CBT and its development, followed by the differentiation between the definition of computer assisted learning (CAL) and CBT. Moreover, an explanation of computing aspects (hardware, and software) is given to illustrate their benefits in CBT structure methodologies (tutorials, drills, simulations, games and assessment). The impact of using CBT in the maritime industry will thus be considered.

2.1 Background of CBT

The idea of using aids for learning and training arose a long time ago, even before the existence of the computer. The idea began in 1924, when Sidney Pressey invented a machine that provided the learner with immediate feedback about whether or not the answer to a multiple-choice question was correct, and the learner was not permitted to move to the next question until he/she had selected the right answer.
(Asksmart, 2002). In the early 1950s, new technologies and techniques promised similarly dramatic changes in the way students were to be taught and learn. Typewriters, mimeograph stencils, television, overhead transparencies, slide tape presentations, photocopiers, electronic calculators, videotapes and others have all raised hopes for educational improvement.

The world has come a long way since the 1960s and most of the 1970s when instructional computing took place on large mainframe computers or occasionally on medium sized computers (Alessi & Trollip, 1991). Near the end of the 1970s computers changed dramatically, declining incredibly in size and cost, and increasing comparably in power and flexibility. As a result, computers have become part of virtually every aspect of people’s lives, including education in schools and at home. Teaching machines, combined with computers, are precursors of both simulators and computer based training (CBT) models.

2.2 Use of CBT

2.2.1 Definition of CBT

One of the sequences of the rapid growth of computers in education is that the terminology has become confused and confusing. There is some confusion between computer-based training (CBT), and computer assisted learning (CAL). These will be considered below in order to try to establish satisfactory definitions.

2.2.1.1 Computer Assisted Learning (CAL)

Computer assisted learning is defined by Vanstone, (1997, p. 68) as “… a method of presenting a programmed schedule of events using a computer. The events can comprise audio, video, photographs, graphics and moving pictures in the form of video and/or animations in any combination”. Thus, CAL is concerned with the use of computers to mediate in the flow of information in the learning process. This information may be a flow between the learner and his/her studies’ advisor (tutor) to feedback his/her progress or information about a model on which he/she is working.
Moreover, the computer can control and coordinate information from other sources, such as slide projector or digital video desk (DVD). Also, it can make sophisticated decisions such as what course a learner can follow next depending upon his/her progress (Husen, 1985). Distinction might be made between CAL and CBT on the grounds that the aims and methods of training are rather different from those of education. However, both are concerned with learning, and in practice there are more similarities than differences between them.

2.2.1.2 Computer Based Training (CBT)

The Nautical Institute (The Nautical Institute guidance… 2001), has researched and debated the role of computer based technology in training and assessing seafarers, and defined CBT as: “… a broad generic term to describe how computer-run software can be used in support of training applications. These may include initial training or for imparting or reinforcing underpinning knowledge”. Furthermore, Dumbleton, (2001, p.3.3) gave a specific definition of CBT for mariners:

CBT for mariners are courses which:

1. Are used by students without the need for support or assistance by instructors.

2. Have built in assessment and produce records of the training time and the student identification.

3. Are interactive.

4. Use multimedia technology.

5. Are run on standalone PCs, networked computers, the Internet, or corporate Intranets.

6. Are run aboard ship or at shore side locations.
However, Eldridge, (2000, p. 2.3) defines CBT as: “… simply another means of delivering good quality training. If we treat it as a separate issue, we are in danger of giving it more than deserves”.

The former two definitions give a broad view, in the author’s mind, as to how learners, seafarers, and instructors describe CBT. Thus, we may consider CBT as an interactive training using the computer as a delivery medium. The usage of multimedia (the integration of text, photos, graphics, animation, sound and full motion video) creates a dynamic communication environment for learners. CBT, however, does not replace the instructor. Rather, the instructor becomes more effective since the learner will have more time to devote to supervision and counseling (even by e-mail).

2.2.2 The computing aspects

2.2.2.1 Hardware

There is a key factor which sets the computer and CBT apart from other instructional equipment and media. This is its ability to control other pieces of equipment and hence the presentation of material through media. Figure 2.1 shows some accessories, which might be used with CBT (but by no means all). Some accessories are concerned with the presentation of information to the learner, such as the synthesized audio output, the display screen, the random access color slide or microfiche display and the video desk (Husen, 1985). Others, such as the keyboard, the light pen, the joystick, and speech input are concerned with the input by the learner to the system.

2.2.2.2 Software

The hardware is the core of the computer, which can carry out instruction for a specific function called a program. The set of programs for different functions is called the computer software. Each CBT package (a tutorial, a simulation, or a package for browsing) will require a separate set of programs to specify precisely
how the information is to be processed and how the interaction will proceed (Husen, 1985).

2.2.2.3 Sample Software
Chehe (1993) gave an example for software, which can be used in CBT, called Mariner. Mariner is shipboard application software designed for the simulation of bulk carriers’ loading and unloading operations. It consists of a group of programs (different functions such as the displacement, the trim, the sheer force, and the bending moment), which acts as software, which runs under DOS 3.0 or higher with a color monitor. Mariner is a simple example of using a limited configuration of hardware (it needs only a color monitor, 486 compatible CPU, and 3.5? desk drive). There is no help feature due, according to Chehe, to the simplicity of the menu, which makes the exploitation of the program very easy. However, the author considers that the help feature is an important issue for any standalone software, whatever the

*Figure 2.1 Some possible components of a CBT system*
simplicity of it, as in the case of any problem a learner who uses this software has no other possibility for solving that problem rather than the help feature, unless the software is used only in the classroom or for online learning. There are many other more sophisticated applications of using CBT as presented in chapter 4.

2.3 CBT structure methodologies (models)

Training is an important issue in the maritime field and may be carried out in schools, onboard ships, or at the trainee’s home by using CBT programs. Below the author presents five CBT structure methodologies (tutorials, drills, simulation, games, and assessment), any one of which could be used in training with standalone PCs.

2.3.1 Tutorials

Tutorials aim to deliver information, skills and guidelines through the initial use of information and skills (Alessi & Trollip, 1991). Figure 2.2 introduces the structure and sequence of a typical tutorial.

![Figure 2.2: The general structure and flow of a tutorial](Source: Computer-based instruction (Alessi & Trollip, 1991).)

The introductory section may include the title, aims and objectives of the training, prerequisite background knowledge and directions, as appropriate. This is to be followed by presenting the information and/or skills, which could be shown as text, graphics, sound or a combination of these.
At this stage a cycle begins by asking questions and seeking responses from the trainee, then the program will judge the trainee response and give feedback. Feedback may take many forms, including text messages and/or graphic illustrations. Its most common function is to inform the trainee about the appropriateness of the response. The cycle may continue by moving to another phase of the training or it may be closed either at the end of the tutorial, or by the trainee. Usually there is a summary at the closing stage.

2.3.2 Drills
The computerized drill is a methodology used primarily for trainee practices for retention and fluency of the training process (Alessi & Trollip, 1991). Figure 2.3 illustrates the general procedure of a drill.

![Diagram of drill procedure](image)

*Figure 2.3 The general structure and flow of a drill*
*Source: Computer-based instruction (Alessi & Trollip, 1991).*

The introductory section, usually as the tutorial methodology, is followed by a cycle which commences by selecting an item; for example, spelling and English usage at which the trainee may select the tense or the degree of difficulty, which could be random or in a specific order. Alessi & Trollip, (1991, p. 93) stated that, “Some terminate the drill after a hundred items, some after thirty minutes, and some after student performance reaches an acceptable level of quality”. The cycle continues by seeking the response from the trainee to given questions, judges the response and
gives feedback to the response and may give corrections to the wrong response. The process may continue to the end of the drill and then provide a summary and evaluation to the trainee, or the trainee may close it at any stage of the cycle. This methodology assists a trainee to practise the subject, but it does not touch on new information.

2.3.3 Simulation
As the trainee becomes increasingly competent in dealing with the simple case, the simulation then adds details to bring the trainee close to the reality. This simple statement could answer the question raised by Mitropoulos (1996, p. 184) “Where and when did we embark on training using simulation?” Figure 2.4 illustrates the general structure and flow of simulation.

![Diagram of the general structure and flow of simulation](source: Computer-based instruction (Alessi & Trollip, 1991)).

As in previous methodologies, it commences with the introductory section, followed by a cycle that begins with a presentation scenario (e.g. briefing in a full mission simulator), which could be the demonstration of the task or just a textual explanation, depending upon the scenario. Then, an action is required from the trainee; for example, if the task is about the rules of the road, the required action could be to demonstrate usage of the appropriate rule to avoid collision in the current situation. According to the action taken by the trainee, the system will be updated, i.e. if the trainee uses a wrong rule, which might cause a collision, the system may stop.
It can be noticed that simulations have advantages over other methodologies such as the enhanced motivation of the trainees, better transfer of training (close to reality), and greater efficiency. However, there are some limitations for the simulation technology in that it is a part of reality reproduced by the scenario designer, which is not an exact copy, even though an exact copy is not always required (Hensen, 1999).

2.3.4 Games
Games are similar to simulation, to a great extent, as both provide an environment that facilitates training and the acquisition of skills. Moreover, their effectiveness is based on the fact that nothing is more relevant to the trainee than his/her own reactions, understanding, observations, and beliefs (Hoyt, 2001). Hoyt encourages using games onboard vessels, as seafarers will enjoy the training and will not feel it is a drudgery interfering with their free time. Figure 2.5 illustrates the general structure and flow of games. After the introductory section, a cycle commences (as simulation) by presenting a scenario and the required action. Then, another small cycle will be created depending upon the reaction of the trainee (player), until he/she gives the final response, from which the system will be updated to allow a move to the next step or to reach the end of the game. At the end of the game, it is recommended that the system displays a message stating that the program is ending, because the trainee may wonder if the program has malfunctioned. This methodology of using CBT could be clarified by the following example given by Hoyt, (2001, p. 12.3):

Traditional games like crosswords and word jumbles, prepared with varying levels of difficulty help in creating a better vocabulary and understanding of the English language for seafarers who do not have English as their primary language. The use of shipping terms and the standard maritime communication phrases further helps in the training of the seafarers.
2.3.5 Assessment

Assessment is used for many purposes, including the determination of a learner’s knowledge (what he/she knows, and what he/she does not), and ranks learners in order in terms of performance, language level and others. CBT is used for assessing individual performance against the agreed competency standard (the outcomes required in the workplace) in many countries e.g. Australia and the United Kingdom (Fisher & Muirhead, 2001). Figure 2.6 shows how CBT could be used in assessment.

Figure 2.5 the general structure and flow of games

Figure 2.6 the general structure and flow of an assessment
Firstly, instructions should be given to clarify the procedures and methodology, to be followed by the learner’s responses, followed by presentation of the first question (or package of questions). Then the system will save the response (answer) and move to the following question and so on. The program will be closed after the learner answers the last question. At the end, the system will judge the answers against a specific standard, and present the score (marks) to the administrator.

Thus, using the computer-based assessment has an advantage for the administrator (instructor) to have a pool of answers, which he/she can use for evaluating the questions and improving them. However, this has the disadvantage of limiting the questions in the short answer format, such as multiple-choice or matching, with the difficulty of judging open-ended or extended test items.

From an understanding of the previous methodologies, the basis of the successful use of CBT will depend upon choosing a correct methodology for the subject to fulfill the objectives of the training. For example, when using CBT in principles of navigation for junior students, and the objective of the subject is “the student will be able to explain the fundamental information of the coastal navigation and nautical publication”, tutorials will be the best methodology to achieve that objective.

2.4 Recognition (Validity)

The rapid growth and development of using the microcomputer in education and training for Computer-assisted learning (CAL), and computer-based training (CBT), has encouraged many producers to produce a huge amount of materials for both education and training methodologies. However, the problem of credibility should be considered. What? And Who? What are the criteria to recognize such packages of CAL or CBT? Is there a benchmark or performance standard to identify the validity of such a package? It is the instructors themselves who have the experience of teaching their specific students to recognize and approve that package. So, it could be said that such criteria depend upon instructors who can understandably be sceptical.
towards anyone who offers an alternative, computer-based approach claiming it to be better because it is individualized, provides deeper or different insights, or is cheaper (Rushby, 1987).

Who has the right to recognize such a package? The answer, of course, will be the International Maritime Organization (IMO). IMO sets the performance standard for simulators and other provisions in section A-I/12 of the Standard of Training, Certification and Watchkeeping (STCW) convention. Table 2.1 shows general performance standards for simulators used in training, which under the amended convention is having a profound influence in training. Furthermore, Muirhead, (1995) argues that if ships are to be operated safely and efficiently, and the public reassured of good quality standards, specialized training programs must support the new technologies. CBT is an effective method of acquiring knowledge, understanding and skills depending upon the degree of sophistication and a program’s interactivity. Moreover, Fisher & Muirhead (2001, p. 102) state: “In developing requirements for simulation training in the revised convention, early work by IMO indicated that it would be very difficult to establish technical performance specifications for different types of simulation”.

Thus, performance standards are very important for recognizing and giving the credibility for such a package in the absence of technical performance specifications for different types of simulations. The performance standards of a simulator could be used for recognizing CBT packages, as CBT is considered the first level of simulation. Even though, in a discussion with a producer manager (Videotel) concerning CBT packages and the recognition of their products, the author was told that till now (January, 2002) no authority approves their products, but they depend upon IMO expertise to produce such packages, together with the expertise of the Nautical Institute.
2.5 The impact of CBT in the maritime industry

Computer-based approaches (CBA) have a great role in the development of maritime education and training (MET) in all nations (developed and developing countries), to cope with the development of the international sea trade. Due to the economies of scale, ships become bigger, faster and enter ports more frequently, which limits the available time for ship operations (loading, unloading, stability calculations, maintenance work program and others), and crew training. This encourages modern
ships today to depend upon a built-in Local Area Network (LAN) to benefit from the availability of managing ship-to-shore communication and daily operations via satellite (Muirhead, 2001).

Thus, because of the limits of time and ship turn round time, more people are required to work in positions of responsibility in shipping companies, ports, administrations and other maritime enterprises where shipboard practice is an advantage. This has two effects, first by creating a shortage of seafarers, and second the lack of time to train staff in the traditional classroom (especially in countries which have no MET institutions). The solution might be through using CBT, and other modes of the computer-based approach (CBA), which is considered a part of advanced technology. Advanced technology is not limited to using computers in training but is extended to cover all operations in the maritime industry such as operating container terminals, Vessel Traffic Management and Information Systems (VTMIS), Integrated Navigation System (INS), Integrated Bridge System (IBS), and others. Thus, the usage of a computer-based approach and advanced technology has a great impact on the maritime industry. This aspect has been discussed by Zade, (1996). Some of the main points that arose are discussed below.

- The wide use of advanced technology in shipping companies has facilitated the communication with their ships and has allowed them to be managed from the head office. This will reduces the independence of shipboard personnel from shore influence, and also assists in the efficient implementation of the International Safety Management (ISM) code.

- The wide use of advanced technology in ports has increased the cargo handling operations efficiency and reduced the lay times in ports. Ships now spend most of their time at sea with very limited time in ports (some types of ships such as container vessels, car carriers, and bulk carriers spend only a few hours in port), which has another impact on the number of young people who want to join
maritime institutions as they feel that it is hard work without any attraction to visiting foreign countries (From the author’s experience a student who left the academy after a few weeks because, as he said, he does not like to live in an uncomfortable steel box at sea to visit countries, which he will not be able to see).

- The wide use of advanced technology in port approaches, in the form of VTMIS, has reduced the independence of the ship’s master in taking decisions near ports and has increased safety in confined waters. Moreover, the movements and behavior of ships are monitored which has an impact on the safety of navigation and reduces and controls the marine pollution.

- The wide use of advanced technology on ships has increased the dependency on modern instruments in the bridge and engine room. Moreover, it has led to a reduction in the size of crews, which impacts negatively on the seafarers’ psychological requirements and it is a cause of additional stress.

- The wide use of advanced technology in MET institutions has improved the quality and effectiveness of training. Muirhead, (1998, p. 222) said: “The use of personal computers (PCs) for computer assisted learning (CAL) within networked systems, supported by Internet and e-mail services is quite widespread in Europe”. The wide use of advanced technology is taking place not only in developed countries, but it is also extending to developing countries, mainly in the form of simulators. The use of simulators is not only for mandatory courses according to STCW (Radar and ARPA), but extends to the full mission simulator as at the Arab Academy of Science, Technology and Maritime Transport in Alexandria, Egypt. The impact of using the computer-based approach as a part of the advanced technology is summarized by Zade, (1996, p. 41) as follows:

  In summary, the increased use of advanced technology in the maritime sector has resulted in a shift of requirements from physical to psychophysical and
psychological ones. It has also resulted in a facilitation of communication and has helped shipping companies to adapt to requirements in a global market.

In short, the wide use of computer-based approaches and advanced technology, in parallel with the effective implementation of the revised STCW convention and ISM code is collectively aimed at providing a standard legislative framework of training and an improvement in the maritime industry.
CHAPTER 3
The role of CBT in the current development
of education methodologies

Traditional CBT is slowly giving way to a new generation of educational software, and a new image of how the computer can be used educationally. The new software does not emulate traditional curricular methods and materials, textbooks, workbooks, chalkboards, filmstrips, and overhead projectors. Rather, they exploit the vast memory, logical structures, and impressive graphic capabilities of computers to produce an interactive, flexible, and powerful medium for teaching and learning. The corresponding new image of the computer in education is as a tool for learning rather than as the latest audiovisual device. In addition, learning resources are considered to be at the heart of the education and training processes, whatever the modes of education and training, either in MET institutions or onboard (Kennerley, 1997).

This chapter concentrates on the provision of learning resources. The first part discusses the use of CBT as a learning resource in the form of textbook, computer-based knowledge management (CBKM), and computer simulation, either as a self-study tool, or in learning at a distance. The second part is a contrast between traditional teaching and using CBT. It commences with a brief explanation of the major teaching methods, lecturing, small group teaching, and private study. What follows is a comparison of some areas, which include speed, teaching tools, browsing, experience, and assessment. In addition, an explanation for combining
traditional teaching with self-study and the use of the computer “blended learning” is given.

3.1 CBT as a learning resource

3.1.1 CBT as a textbook

“Computer-based training can start with a book and better illustrations and links to further information” (Lyras, 2000, p. 41), as some materials can be covered with such simple inexpensive CBT. A single compact desk (CD) is capable of containing as much as 600,000 pages of information, or 2,000 books, which means there is no limitation of resource materials, that could be available in MET institutions, or onboard as a CD library (Muirhead, 1995). Moreover, books on CD have the advantage over textbooks when adding clips, sound, graphics, animation or any other available method of presentation via computer. Graphic presentations greatly enhance instruction about spatial relationships, about objects or procedures that can be visually depicted, or for modeling (showing a student/trainee how to do something). Animations allow the computer to demonstrate changes, processes, and procedures in a way few other media can. Sound is a presentation mode quite different from either text or graphics (visual modes). The common use of sound in CBT is for primitive sound effects such as beeps or explosions, not as advanced as the visual modes.

Furthermore, Muirhead (2001, p. 3), clarifies the advantage of using computer over the textbook that:

Today, access to the computer and the Internet means a changing learning environment, one that is much more student centered. Educational research indicates that we learn 70% of what we see, hear and do. If that is the case, the combination of computers, networks and multi-media capabilities is clearly a formidable educational tool.
In addition, the index system, which allows a student/trainee to go through the book and choose the required or interesting part for him/her, will save time and could make it easier to find the part suited to his/her level of knowledge. In short, students/trainees need to be able to use computers flexibly, creatively, and purposefully to achieve their objectives, such as using the Interactive Compact Desk (CD-I), which allows a combination of a high degree of reality with hands-on interactive involvement on the part of the user (Muirhead, 1995).

3.1.2 Computer-Based Knowledge Management (CBKM)

“Knowledge management, a sister discipline to training can provide a total picture of the learning curriculum, provide true orientation of the trainee to the learning material and connect the trainee’s vocational activities to reference information that cannot be memorized easily” (Lyras, 2000, p. 4.2). The previous part of this chapter referred to the importance of indexing and how it is useful for students/trainees to reach their knowledge. In this part, an explanation of the necessity of indexing will be carried out in the form of managing the available knowledge. Reference books, video films, seminars, and instructor office hours are all considered scarce resources, which could be covered by using CBKM. A CBKM system may allow students the use of limited resources, such as videotapes, or reference books from their own PCs, or via a network either within the campus, or at home via the Internet. Moreover, students will not have to ask teachers for office hours as the teachers can provide more materials or explanations through the network.

A good example of managing knowledge is the World Maritime University (WMU), which uses its own Intranet system. The system runs on a microcomputer network and manages a database stored on a mass storage device (a large hard disk drive) available to all microcomputers on the network. The database contains many items: test item files, objective and curricular files, student data files and others. When lessons are not copy protected and contain more compatible data and entry/exit formats, the system may control the routeing of students between lessons, interpret
data generated by lessons, and pass on useful information for the lessons (such as handouts, power point presentations, or previous lesson progress). Moreover, there are links with related web sites through the Internet, which allow students access to all available publications, even new IMO publications. Thus, managing knowledge should be at the heart of curriculum design to provide students with the required learning resources either through traditional methods (e.g. textbook), or by using the stored database (Kennerely, 1997).

3.1.3 Computer simulation

“A subset of CBT programs is based on simulations of the real world. These simulation-based programs usually have lower physical fidelity than simulators” (Farmer, Rooij, Riemersma, Jorna & Moraal, 1999). Computer simulation, as an educational tool, is relatively new and is rarely specifically referred to in the various learning theories. However, educational theories which support “learning by doing” give credibility to computer simulation as an educational tool (Mercer, 1996). Thus, using computer simulation will motivate the students to learn by interacting in a different manner close to real situations. Students gain the skills of solving problems, learning procedures and understanding the characteristics of phenomena and how to control them safely and efficiently.

These skills can simply be gained by students since most CBT systems are quite simple and straightforward, for example knowledge will be presented and followed by a set of questions to make sure that he/she has understood the information presented, and can apply it in different environments (Farmer, et.al. 1999). Furthermore, a good computer-based training simulation course can provide students with tremendous knowledge, skills and experience, all of which will be useful in achieving the subject’s aims and objectives. Thus, such a course can be carried out onboard to train junior officers, or senior cadets to learn, for example how to use new equipment, how to behave in the event of collision cases under COLREG, how to control the ship as an independent officer of the watch (OOW), etc.
In short, simulator-based training is available for cadets and seafarers in navigational maneuvering, communication (GMDSS) and engine room systems. Such simulator-based training basically caters to intelligent-interactive computer based training where an actual board situation is simulated and action needs to be taken safely and efficiently (Lyeras, 2000).

3.2 CBT in distance education

The structural changes taking place in the maritime industry may have consequences for education and training. In addition, the maritime industry needs to find ways to train seafarers in maritime skills quickly and cheaply, either onboard vessels, or over the Internet while they are at home, which can be cheaper than taking them off vessels to spend time in MET institutions (Digital Ship, 2000).

The rapid development of computer networks, dramatic improvements in the processing power of the personal computer, striking advances in magnetic storage technology, and the developments in communication’s technology in the 1990s has encouraged educators to benefit from using the computer in distance learning in the maritime industry (University of Idaho, 2002). The environment of distance education has continued to evolve with advancing technology to where knowledge and instructions are delivered by using a combination of live, two-way interactive audio, video or both and synchronous/asynchronous computer–based interaction. Moreover, the use of Local Area Networks (LANs), the Internet, Wide Area Networks (WANs) and the World Wide Web (WWW) extend the opportunities of learning to new students to make learning more efficient and flexible, and to enrich the learning processes.

Furthermore, distance learning enables students/trainees to receive personalized learning and training material via their computer terminal, and where appropriate the software could contain existing video streaming and simulation training. The program may also have the capacity to simulate the facilities available to an actual
college or university. For example, if WMU staff try to train their students in English at home instead of teaching them in Sweden for 17 weeks, it will be possible, via distance learning for students to attend tutorials, look at notice boards, and contact other students. Moreover, the administrative side of the university will be maintained with progress made and records of achievement (if the problem of lack of required Internet infrastructure is solved in developing countries). In this example CBT can play an important role in using the available English training course at WMU. Thus, students benefit from the response and feedback and the links developed with the tutor/teacher from a rapid perception and understanding of the student’s difficulties and rate of progress (Muirhead, 1994).

On the other hand, the Internet is developing as a repository for good quality information that can be used for undergraduate and post-graduate level study, and the Internet thus is becoming a good alternative to the campus library in some ways. As long as connections are working, students can read, print, or download the references they need, or the materials sent by tutors. Moreover, CBT as a learning tool could be more effective when using the new technology called broadband. Muirhead, (2000, p. 11) clarifies the importance of this:

As a result of advancing broadband technology in the 21st century, sophisticated simulation training programs will be capable of being accessed onboard (and ashore) via Web Education Management System (WEMS). Such single-task or part-task simulator activity could be monitored and recorded by the institution (or company training officer for that matter) in preparation for further advanced training on simulators ashore.

In conclusion, CBT acts as an important tool when using distance education in training onboard or ashore, as the modern sophisticated simulation programs could be downloaded via the Internet and students/trainees train on their own computers.
Moreover, it will also benefit shipowners to use such CBT programs at a distance, as the cost will be lower.

### 3.3 CBT vs traditional teaching methods – a critique

Teaching may be regarded as providing opportunities for students to learn, and it is a complex intellectually demanding, and socially challenging task. It consists of a set of skills that can be acquired, improved, and extended (Brown & Atkins, 1999). There are various methods of teaching, such as lecturing, small group teaching, research supervision, lab work, self-instructional systems, and private study. Figure 3.1 clarifies the role of the lecturer and the student. In this part the author concentrates on the comparison between the traditional methods (e.g. lecturing and small group teaching), and private study.

![Figure 3.1 a continuum of teaching methods](source: effective teaching in higher education (Brown & Atkins, 1999))
3.3.1 Traditional teaching

3.3.1.1 Lecturing

Lecturing may be traced back to the Greeks of the fifth century BC, as the term lecture was derived from the Medieval Latin *lectore*, to read aloud (Brown & Atkins, 1999). The role of a lecture is to send messages to his/her audience, which must be adapted to suit their needs. Such messages can most effectively be delivered not only verbally (by definitions, descriptions, examples, explanations, or comments), but also with the support of instructional media. Fisher and Muirhead (2001) illustrate such instructional media to include handouts, posters, wall charts, flip charts, physical models, (e.g. ship structures), magnetic sheets, and shapes (e.g. for Rules of the Road instruction), whiteboard/blackboard, and overhead transparencies. However, it is vital that the lecturer does not overestimate the knowledge that the audience has at the commencement of the lecture (Ives & McEnaney, 1997).

Moreover, figure 3.1 shows that the lecturing method is at one extremity of the continuum in which student control and participation is usually minimal. Baillie (1997, p. 15) elaborates that as:

A teacher or instructor is many things. He (or she) is a source of knowledge, a demonstrator of skill, a judge of standards, a mentor passing on the values and expectations of his main occupation, one who encourages, steers and prompts those who want or need to make progress, and shares the pleasure of success and the disappointment of setbacks.

However, students may choose what notes to take, whether to ask questions, or even disrupt the class. In short, coverage of a topic is the most commonly expressed goal of lecturing, even though using audio-visual aids, attention to understanding and motivation are also necessary.
3.3.1.2 Small group teaching

Small group teaching has a long history. Its great proponent was Plato’s teacher, Socrates, who valued the development of attitudes as much as critical thinking (Brown & Atkins, 1999). Small group teaching has an important role as part of a range of training and educational options, which are increasingly being owned and managed by the student. Brown & Atkins (1999), classified small group teaching as tutorials, seminars, and problem-solving classes, and suggested that tutorials contain up to five students, seminars perhaps as many as twenty, and problem-solving classes may have up to thirty students. On the other hand, the author’s view, which is supported by Fisher and Muirhead (2001), is to add the buzz group to the previous classification, and the size of these categories is usually about ten, but occasionally may be as high as twenty.

Figure 3.1 shows that in small group teaching, student participation and control is greater than lecturing, and the lecturer may act as a facilitator to the flow of the discussion among the students. Thus, it will encourage students’ thinking generally and in that subject specifically. For small group teaching to be effective, the task must be managed carefully, in the form of the style and management of the leader, and the layout of the seating of the group (Fisher & Muirhead, 2001).

3.3.2 Private study

The last three decades has seen a dramatic shift in the conception of teaching, where learners are seen as active processors of information (Brown & Atkins, 1999). The wide use of the computer, which is like any educational tool, comes with inherent advantages and disadvantages, is more appropriate for some uses than others, is more suited to some teaching style than others, and is neither the answer to all educational ills nor the end of all that is great and good in the educational system. Like any tool it can be used well or poorly, be overemphasized or ignored, and it depends upon the human qualities of the wielder for its effectiveness. The computer could be used in
many forms as an educational tool, CAL, CBI, CBT, and others either as a stand alone PC, or as a tool in distance education (as discussed earlier in this chapter).

Furthermore, the computer ensures the complete or partial replacement of the teacher and creates adequate conditions for the cognitive activity of the students, while being sufficiently universal in coping with a wide range of information available via the Internet. In principle, it can be used for teaching a number of subjects at all stages of learning, even onboard training, and increase the quality of students’ learning. Figure 3.1 indicates at one extreme private study in which lecturer control and participation is usually minimal. Moreover, the control which a student has over his/her own learning may apply to how a subject is learned, as when the learner’s own cognitive representations and strategies are allowed room to be used, in addition to what is learned, as during the exploration of that subject matter or environment (Ward, Sewell, Rostron & Phillips, 1987).

Table 3.1 Academic staff access to computing technology and multi-media

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<th>Europe No%</th>
<th>Asia-Pacific Yes%</th>
<th>Asia-Pacific No%</th>
<th>Africa-M-East Yes%</th>
<th>Africa-M-East No%</th>
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<td>Color printer</td>
<td>95</td>
<td>5</td>
<td>80</td>
<td>20</td>
<td>67</td>
<td>33</td>
<td>91</td>
<td>9</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td>Digital camera</td>
<td>76</td>
<td>24</td>
<td>48</td>
<td>52</td>
<td>25</td>
<td>75</td>
<td>83</td>
<td>17</td>
<td>62</td>
<td>38</td>
</tr>
<tr>
<td>Multi-media</td>
<td>54</td>
<td>46</td>
<td>72</td>
<td>28</td>
<td>42</td>
<td>58</td>
<td>42</td>
<td>58</td>
<td>55</td>
<td>45</td>
</tr>
</tbody>
</table>

Source: CBT @ sea 2001 conference (Muirhead, 2001)

However, students seek suggestions from the lecturers, materials that he/she has provided and the texts that are made available in the library (Brown & Atkins, 1999).
A further explanation, as to the extent to what the use of private study, not only in the form of the computer, but also for other new teaching technology and methodologies, is shown in table 3.1, which is extracted from the study done by Muirhead (2001) in a comprehensive survey of MET institutions around the globe.

3.3.3 CBT v traditional teaching
Teaching is an interactive process as well as an intentional activity. In the maritime field, one goal of teaching is to raise the professional standards of seafarers through learning, alone or in a group, at sea or ashore (Baillie, 1997). Teaching could be one-to-one teaching, or a large students-to-instructor ratio in a conventional classroom, or private study, for example by using CBT. The first method is the most effective but it is very costly, and requires a large number of lecturers. In the next section, a comparison between traditional methods (students-to-instructor), and using CBT will be carried out.

3.3.3.1 Speed
Lecturers in traditional teaching control the pace of delivering the knowledge, which could affect the students’ understanding and learning. For example, at WMU where many lecturers are lecturing at different speeds, it is common for the students to record some lectures to listen again (sometimes for language purposes at home). On the other hand, CBT offers a means for providing lectures in any CBT structure methodology, at a pace that can be controlled by the learner. Moreover, the lay image of CBT is of serried ranks of students, or individuals, each seated in front of a computer keyboard and screen, all learning in their own way and at their own pace. The importance for each student to learn in his/her own pace is clarified by Lyras (2000, p. 4.4) that, “… you are likely to retain only a small percentage of what you read or hear unless you control the pace of delivery, and seek answers to your own relevant questions when it becomes necessary in your own mental process”.
3.3.3.2 Teaching tools

Teachers have long used visual and auditory modes in trying to get ideas across, which have often been the most prominent on college campuses. Texts, tests, writing on a blackboard/whiteboard, all are primarily verbal, while the adaptable visual aids, such as overhead transparencies, and the use of power point presentations are all presenting the teaching tools in the traditional teaching. In addition, lecturers should have lecturing skills, such as presenting information, explaining, and generating interest. These skills in their turn are based upon the specific skills of opening a lecture, using audio-visual aids, comparing and contrasting, narrating, varying activities, and summarizing (Brown & Atkins, 1999).

On the other hand, CBT is interactive teaching using the computer as a delivery medium. The usage of multimedia, such as text, photos, graphics, animation, sound, and full motion video (FMV), creates a dynamic communication environment (Holder, 2000). However, using technology should be for the benefit of the students and not be distracting. It is therefore, important to have clear and easy-to-follow graphics that not only help gain and maintain student interest, but also make the technology transparent, shifting the focus from the technology to the educational process.

3.3.3.3 Browsing

One difficulty, among many difficulties facing students in traditional teaching, is memorizing. Even though lecturers are concerned with the clear transmission and useful coverage of subjects, students are still taking notes for the accurate recall of definitions, facts, formulae, procedures—perhaps assisted by worked examples (Brown & Atkins, 1999). Moreover, students need to read the provided text by the lecturer, find out materials from the library to get whatever they have missed in class, or they have to ask the lecturer to repeat. Alessi and Trollip (1991, p. 11) add:

 Much of what we perceive we must store and be able to retrieve later. While the information storage and retrieval capacity of human intelligence is immense,
assuring that the important things are not only perceived but also properly stored is not trivial. Especially when faced with new and large bodies of information, such as the vocabulary of a new language, instructional techniques for efficient storage of information are essential.

In contrast, structure methodologies of CBT use the computer as a mentor and guide through a range of learning resources (database), which might, but need not, be themselves based on a computer. Thus database programs, according to Ward and Swell (1987, p. 145) “… allow the learner to store, manipulate and retrieve information that has been collected by himself or herself”. Thus, the power of the computer to store, retrieve, and process information is used to help the student as he/she browses through the material, responding to questions about related information, retrieving items which are needed, summarizing statistical data, and suggesting possible lines of investigation that may be of interest.

3.3.3.4 Experience
Can CBT deliver experience? The answer from the author’s view is CBT cannot deliver experience. One disadvantage of CBT, as indicated by the Nautical Institute guidance on computer-based training (2001) is “trainees cannot ask computers questions and so are limited to the pre-determined help facilities designed into the training course”. Moreover, Eldridge (2000) argues that CBT cannot deliver experience, as it is the vital and irreplaceable asset that an instructor brings to the topic. In addition, discussion in the conventional classroom also develops skills that are central to most professions: the ability to communicate with others (both professional and lay), and the sensitive and precise handling of the language of the subject. This language contains, not only concepts, facts and processes, but also explicit and implicit attitudes and values. Thus, teachers deliver information and knowledge, in addition to improving the students’ attitudes and values.
The staff particularly teachers, according to Karma and Woon (1996, p. 288) are “… an important role model to students and over time can greatly influence their attitudes and values system. Teachers’ disposition and behavior can help reinforce or undermine the positive attitudes and values already existing in the students”.

3.3.3.5 Assessment

Assessment is the process of determining how much and how well students are learning, and the level of performance of a student/trainee in a particular skill. The purposes of assessment are for motivating students, grading for advancement, and providing feedback to students and teachers (Muirhead, 1997 & Fisher and Muirhead, 2001). The traditional teacher always uses a formal assessment using tests, quizzes, examinations, term papers, and homework or lab reports. Moreover, he/she may use informal evaluation such as, posing questions, listening carefully to student questions and commenting and monitoring body language and facial expressions (University of Idaho, 2002).

This assessment is in general the same as in CBT packages. An example of CBT assessment is presented by Healy (2001), where students get a set of questions at the end of each section (chapter), which gives only feedback without counting the results as a formative evaluation. At the completion of the program a larger assessment is randomly selected and presented, which is compulsory for students to answer, and the results will be counted. However, the difference, as explained in chapter 2, is that open ended and essay questions are difficult to use with CBT programs. Good practices include the relevance of the assessment to the learning, in other words it must be valid and reliable, and the course designer should use a variety of methods of assessment. In addition, questions should be carefully formulated to ensure they are clear in what they require and can be answered without any particular typing skills.
3.4 Blended learning

Another aspect, the author wishes to raise, is blended learning, which is used as indicated by Jackson (2002) to

… seek the optimum blend of self study, instructor-led events, and group collaboration, each potentially deployed in a blend of asynchronous or synchronous modes, appropriate for a learning outcome. It would embrace all delivery vehicles (traditional, web-based, computer-based, etc) and select for that “blend” that best fits the needs of its stakeholders (which would include instructors, students and supporting institutions).

Thus, to create the most effective way to train people in maritime skills is by combining different educational techniques i.e. blended learning (Distance learning in shipping, 2002). These educational techniques may include videos, computer games that teach simple facts, books, written exercises, computer simulation packages, human tutors, classroom training, computer games, CBT, CAL, and actual hands on experience onboard a ship. As a result, trainees can benefit from the advantages of both traditional teaching and self-study, and overcome the disadvantages of both.

Allesi and Trollip (1991, p. 5) summarize the comparison between traditional teaching and using new technology in the form of CBT as “Hundreds of research studies have been performed attempting to prove that using a computer to teach something is better than using a book, a teacher, a film, or some other more traditional method”. Moreover, the CBT package can be used as a class demonstration, under the control of the teacher, either as the main focus of the lesson or to illustrate various points that may arise. This is similar to the laboratory demonstration or the use of videotape (or film strip) with the whole class. The lesson may require some preparation by the students and the demonstration will be accompanied by group discussion.
Chapter 4
Application of CBT

Computers, as discussed in the previous chapters, can be used interactively. Students can test out their own solutions and hypotheses on the computer, receiving immediate and appropriate feedback. They can explore microcomputers to discover navigational patterns, system dynamics, logical relationships, or natural laws. They can program computers to solve problems or perform tedious tasks, such as calculations, or difficult ones, such as drawing diagrams. They can use computers to query databases, store and retrieve information, manipulate and analyze data, and display results in myriad forms. Or, they can do none of these, so teachers can disregard the interactive capabilities of computers. They can use them to provide students with drill and practice of basic maritime skills or with tutorials that lead students through a series of brief questions and answers to arrive at some statement of a nautical concept. They can use computers as electronic page-turners and grade books, as “high tech” demonstration screens, or computer simulation.

This chapter illustrates the use of computers in MET institutions as a learning tool, both for learning about and from computers, and learning with computers. Moreover, it describes the use of computers as a teaching tool by teachers either as a stand-alone teaching media, or for creating teaching materials such as overhead transparencies or spreadsheets. Furthermore, the author presents two applications to show the effectiveness of using the computer in the maritime field. First, using the computer-based training in Maritime English, and second in ship handling operations, and the implementation of simulation scaling at WMU.
4.1 The use of computer in MET institutions

The flexibility demonstrated by computer programs in MET institutions offers one solution to the difficulties, as discussed in chapter 3, of enabling teachers to experience, study, review and discuss practices, methods, approaches and techniques being used elsewhere in the educational system, in their own time, at their own convenience. Moreover, Alessi and Trollip (1991, p. 3) add:

Teachers have a great deal of routine administrative work, such as grading, producing assignments and handouts, writing letters, and keeping track of resources and materials. When a computer can perform or speed up such tasks, the teacher has more time to work with students.

In contrast, computer programs can provide an extremely flexible system that adapts to the aptitudes and abilities of a wide range of students and subject areas, thus allowing students to compare, contrast and follow their own investigatory pathways. The pathways will not be those rigidly determined by the technology and the programmer, but those taken in interactive discussion within the program through the computer. There are three ways to use the computer programs in the MET institutions, learning about them, from them, and with them (Winer & Mothe, 1987).

4.1.1 Learning about and from computer

Due to the wide use of computers onboard ships, MET institutions have introduced computer science as part of the syllabus. An example of introducing computer science, is illustrated by Allard (1994) where French schools started in 1985 to introduce such a subject for students. The course is divided into two years; they teach 56 contact hours per year. Teaching takes place in small groups of 8 to 12 students, and involves lectures, and practical work with one student to a computer.

In addition, one of the great attractions of the computer as an educational tool is the relative ease with which most students can learn to write simple programs, and to develop their own computer learning materials through programming. Moreover, students should benefit from this science by achieving some objectives such as:
1. Knowing and using basic computer terminology.
2. Understanding the basics of programming.
3. Understanding and articulating the relationship and impact of Information Technology (IT) on careers, society, culture, and their own lives (Eisenberg, Johnson & Berkowitz, 1996).

Furthermore, in education, the question of when to use the computer as an educational tool, and indeed whether to use it, is governed by the learning situation.

4.1.2 Learning with computers
One of the most obvious features of development in the field of education today is the increasing emphasis placed on technology and its impact on classroom instruction. As computer technology becomes increasingly integrated into virtually every aspect of social living, and more firmly entrenched in education, its prominence is displayed most clearly through the rapidly increasing use of the Internet, World Wide Web (WWW), Computer Assisted Learning (CAL), Computer Based Training (CBT), e-mail and multimedia tools, which open up the use of networks for educational outreach.

4.1.2.1 Using computers by students
Students in MET institutions need to be in an environment that supports their learning, be motivated to learn, and have the skills, resources and support necessary to help them achieve (MacDonald, 2001). These resources, according to Alessi and Trollip (1991), are beneficial if they are well organized and catalogued. The use of computer databases is beneficial in this regard. Textbooks and articles relevant to the content, instructional design, and the delivery medium may not only be catalogued on a database, but their contents catalogued and described so that the information can be quickly located when needed. Moreover, by using computers in learning, students can receive personalized learning material via the computer terminal, and when appropriate the software would contain exciting video streaming, and simulation training. As illustrated by Winer and Mothe (1987), learning with
computers changes the meaning of the verb “to know” from “having information stored in one’s memory” to “the process of having access to information”.

4.1.2.2 Use of computers by teachers
The role of the modern teacher nowadays is to develop classroom-computer integration that provides students with a high level of knowledge and understanding. According to Muirhead (1994) the advent of the very powerful desktop microcomputer, networking, color graphics and interactive workstations has led to a considerable growth of software use in maritime education and training. Moreover, Fisher and Muirhead (2001, p. 49) state that: “in maritime education and training many good software applications are available to the innovative and imaginative maritime lecturer”. However, teachers are still suffering from preparing teaching materials, including assessing the initial state of their students’ knowledge and individual characteristics, and the development of the teaching program itself as sequences of measures to assure the optimum learning of this material.

The use of database and spreadsheet programs, according to Abella (1995), helps teachers to manage and manipulate any information with important aspects dealing with a certain data or task to perform. Graphical spreadsheet programs such as Microsoft excel offer features, which make them potentially very powerful learning tools in a wide range of classroom situations. They can act as databases; they can produce a large range of different types of graphs; they have libraries of built in functions (logical, statistical, scientific, etc), and their cells can be given names. These cells are interactive so that a change in the value of just one cell causes the whole spreadsheet to be recalculated and any graphs to be redrawn immediately. Moreover, using computer programs such as power point, as a teaching tool, allows teachers to present professional presentations, and media specialists can teach valuable research skills (McMahon, 2002).
4.1.2.3 Example of using the computer in MET institution
An example of using the computer in MET institutions is its use by the Arab Academy for Science, Technology, and Maritime Transport (Islam, 1996) as a databank for assessing seafarers, which determines questions and examinations according to a pre-analyzed standard set of procedures which ensures reliability, validity, and security.

4.2 Selected use of CBT applications
The successful operation of a ship depends primarily on the officers’ knowledge, rule base, and skills. Training and education within each of these three fields are imperative. International regulations such as the IMO STCW standards and ISM Code aim to specify the standard of training and education and also quantify the ability to operate a ship through certification. Moreover, cost-efficient crew training is imperative for shipowners and maritime authorities to improve the economy through higher safety and casualty prevention. The demand for quality training is based on the obvious fact that PC-based simulation courses easily compete with the costs of collisions, and groundings. It is therefore extremely important for the shipowner and educational organization to invest in appropriate quality training. Tools of insufficient fidelity relative to the training objectives may create negative training, which is a completely wasted investment. A load will therefore be placed on the shipowner and training organization in selecting the structured, efficient and state of the art training systems for achievement of higher safety. In the following section the author will present two applications of using PC-based simulation modules for training cadets and seafarers in MET institutions.

4.2.1 Maritime English and the SMCP
English, without any doubt, is the language of the sea, even if the number of native English speaking mariners is relatively small compared to the world total of mariners (Weeks, 1996). This is for certain reasons as mentioned by Weeks: English is the accepted language of international trade; English is the language of the sea and has
been for a very long time, and English has been adopted by the IMO, officially, as the language of the sea. Even though, the analysis of the marine accidents shows, as explained by Kncharzewski (2001), that among the 80% of marine accidents which occurred due to human error, shortcomings in technical and shipboard communications in maritime accidents are steadily increasing. Moreover, STCW 1995 requires that every mariner must have an adequate knowledge of the English language. Table 4.1, which is extracted from table A-II/1 of the same convention, clarifies the importance of Maritime English (ME). In addition, with reference to STCW 95 B-IV (2001) knowledge of, and/or training in the English language, both written and spoken, should be for the satisfactory exchange of communications relevant to the safety of life at sea.

As a result, as explained earlier, IMO established a working group to develop obligatory Standard Marine Communication Phrases (SMCP), which were finally drafted in 1997. IMO has issued MSC/cir 673 “onboard communications for passengers’ care” which details the precise communications that should exist on every ship carrying passengers, particularly ferries. A safety phrase may be defined, as Weeks (1997, p. 275) said “a group of words, which must be exactly geared to the incident concerned, and which must be uttered without variation by everyone of any nationality when finding themselves involved in the incident concerned”.

Furthermore, following the earlier adoption of the STCW Convention, IMO members have suggested developing model training courses to assist in the implementation of the convention and to achieve a more rapid transfer of information and skills regarding new developments in maritime technology. As a result, the IMO model course 3.17 (2000) in Maritime English has been designed to help trainees to develop their communicative competence in English to a level required in the STCW 95 Convention and support instructors to achieve this aim. It gives them an instrument to create and implement appropriate syllabi that meet the needs defined by the STCW 95. Maritime English (ME) and the SMCP can be taught in a
traditional classroom, by using videotapes, or by using CBT programs. As this thesis concentrates on CBT, an application of using CBT in teaching ME & SMCP will be presented in the following section.

Table 4.1 Specification of minimum standard in the Maritime English for an Officer Of the Watch on ships 500 GRT or more

<table>
<thead>
<tr>
<th>Competence</th>
<th>Knowledge, understanding and proficiency</th>
<th>Methods for demonstrating competence</th>
<th>Criteria for evaluating competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use the Standard Marine Navigational Vocabulary as replaced by the IMO Standard Marine Communication Phrases and use English in written and oral form.</td>
<td>English language. Adequate knowledge of the English language to enable the officer to use charts and other nautical publications, to understand meteorological information and messages concerning ship’s safety and operation, to communicate with other ships and coast stations and to perform the officer’s duties also with a multilingual crew, including the ability to use and understand the Standard Marine Navigational Vocabulary as replaced by IMO Standard Marine Communication Phrases.</td>
<td>Examination and assessment of evidence obtained from practical instruction.</td>
<td>English language navigational publications and messages relevant to the safety of the ship are correctly interpreted or drafted. Communications are clear and understood.</td>
</tr>
</tbody>
</table>

Source: STCW 1995, extracted from table A-II/1 (2001)

4.2.1.1 ME & SMCP language training

To demonstrate how active maritime language training in combination with modern learning methods, as speech recognition and Advanced Distributed Learning (ADL), can assist effectively ME & SMCP training in different phrases, MarineSoft
developed SMCP language software program in accordance with the international standards and the IMO Model Course 3.17. The purpose of this application, according to the program manual, is to assist the trainees to master the maritime language and communication based on the SMCP in an intensive and effective way in a flexible learning environment.

The program includes many tasks such as:

- Vessel Traffic System (VTS) including SMCP for training of maritime language and communication.
- Emergency procedures, such as fire onboard, Search and Rescue (SAR), and for training of distress communication and vocabulary based on the SMCP.

**System requirements**
The following system requirements have to be fulfilled:

- Operating system Windows 95 or higher
- Processor: minimum Pentium 166
- Free memory: 600 MB minimum on hard drive
- RAM: 32MB minimum (recommended 64 MB or more)
- Screen resolution: 1024 × 768 pixel and 16 bit colors
- CD-ROM drive
- Installation of software IBM ViaVoice Millennium (US-English or UK-English), sound card, loudspeaker, and headset.

**Vessel Traffic Service (VTS)**
This routine communication module is mainly suitable for training persons like VTS operators and navigators. Based on real standard situations in ship-shore communication, several single communication parts are created in order to train the special phrases and vocabulary. Ship-shore communication covers the following parts:

- Approaching the port
Approaching the port

Approaching the port consists of an introduction into the basic situation as well as a description of seven different situations during the procedure. Every single situation comprises the corresponding on board and external communication.

Leaving the port

Leaving the port combines the introduction situation with five single communication situations, which are mainly external communication completed by the corresponding on board communication.

Pilotage

Pilotage combines the introduction situation with fourteen single communication situations, which mainly describe the external communication between ship and shore, ship and pilot boat, ship and port control completed by the onboard communication i.e. between pilot and crew.

Tug assistance

The module “tug assistance” describes within six situations an arrangement of berthing under tug assistance. The main emphasis has been put on the communication between the ship and port control facilities as well as the ship and the tugs.

Passenger care

One of the most important modules is the passenger care, which consists of seven different situations. First is an introduction situation followed by six different single
communication situations. These situations mainly describe the onboard communication between the captain, officers, and the passengers. The importance of this module is to teach the crew of the passenger ships/ferries how to manage the passengers during emergency situations, which include fire onboard, and search and rescue.

**Emergency procedures**

➤ **Fire on board**
As described earlier, the problem onboard passenger ships/ferries is how to manage and instruct the passengers. Thus, this module through an introductory situation and seven single different communication situations, gives training in using the necessary phrases to master the situation properly. This module is mainly designed for training masters, officers, and crew members to manage the crowd of passengers in case of emergencies.

➤ **Search and rescue (SAR)**
There is a problem with the search and rescue phrases because such phrases are not used in daily routine work. Thus, within the introductory situation and twelve single communication situations, this module describes the distress communication among the ships participating in a SAR operation, and VTS as well. Masters, officers, and crew members should practice using these phrases correctly and without any hesitation, in case of emergency.

**Working the module**
After a successful installation the user gets a path entry under Programs / Marine Soft / Marine Training / SMCP, at which the trainee can select the SMCP module and start it with a mouse click. Figure 4.1 shows the opening screen for all modules. The user can start the application by clicking on the marine soft logo, thus the introduction screen will appear, which is the same for all modules. The user has two options: First, to start the SMCP training by clicking the language trainer button, then
he/she can practise the whole course syllabus of the SMCPs in accordance with the IMO Model Course 3.17. Second, the user can go directly to an exercise or a test by using the corresponding button, for example with competency test he/she can only practise the chosen exercise in the language training application.

Choosing the main menu screen, which is the starting point for all training activities of the users, covers three main items:

- Situations to start the different scenarios and provide a description for each scene of the selected scenarios as well as to read and to listen to the corresponding communication.

*Figure 4.1 opening screen for all modules*

*Source: MarineSoft*
Training
1. Competency
2. Communication
3. Language

Evaluation
1. Competency tests
2. Language assessment tests

Figure 4.2 Introduction screen for all modules
Source: MarineSoft

Exercise window
The exercise window consists of a box in the center with the exercise text and an input box in the lower left corner into which the user types his/her answer or opens the pull down menu to select the right answer from the list. The availability of an answer list for a specific task/question is determined by a little arrow which appears
in the right next to the input box. The headline in the box describes what the user should do, for example choose or listen. Moreover, the user can see what question number he/she is working on from the exercise textbox, that is followed by a sentence with the insertion point. The task is to find the correct word or answer to insert in the sentence or to define the type of the shown sentence.

![Main menu screen](image)

*Figure 4.3 Main menu screen  
Source: MarineSoft*

The answer should be typed in the input box at the bottom or appears in this line by using the listen and speak section. A pop-up screen will appear in case of any inputs typed incorrectly, telling the user that it is an incorrect solution. Then the user has three options: OK, help, and answer. If the user wants to try it again, he/she should confirm with OK, while he/she can seek help by selecting the help button. However,
he/she may use the answer button, if he/she does not know the answer after using help, which opens a list of the correct answer possibilities. In addition, all results can be shown to the user after finishing an exercise completely, in the markbook screen. Each user has his/her special result markbook stored in the common database.

![Different modules (Scenarios) screen](source)

*Figure 4.4 Different modules (Scenarios) screen
Source: MarineSoft*

**Markbook**

Figure 4.5 shows the markbook window, at which all the marks shown for an active user in relation to the section in question. The window presents how many correct answers achieved by the user in the section, and how many levels and exercises are available for training.
Show answers

Show answers window, as shown in Figure 4.6, includes all correct and incorrect answers for the section, which has been highlighted. Moreover, the user can determine the time spent in each question, and whether he/she answers that question at the first attempt, or he/she used the answer button. By closing this window the user returns to the markbook.

Marking system

The marking system consists of a percentage scale. Points are awarded to the user in the following way:

1. 3 points - for each correct first attempted answer
2. 1 point - for a correct answer with or without help
3. 0 points - for a correct answer where answer button is used
4. 0 points - for an incorrect answer with or without help

The built-in pedagogical structure will determine which exercise the user should be given as follows:
1. If the user scores more than 92% in an exercise, he/she will continue to a higher level, for example from exercise 1.1 to 2.1.
2. If the user scores between 50% and 91%, he/she will continue to the next exercise at the same level, for example from exercise 1.1 to 1.2.
3. If the user scores less than 50%, he/she has to repeat the exercise. When he/she has repeated the exercise, then he/she can continue to the next exercise in the same level.

The personal progress determines the learning path through the program.

Furthermore, the program can run for a number of users. The number refers to how many users can access the program at the same time, by using the system administrator. The system administrator module is the system administrator’s tool to make all the necessary changes in the student’s personal data. Students can create
and be given access to the different programs; their progress can be observed and their grades are viewed, printed, compared and analyzed. The system administrator module can also help students who have forgotten their passwords to the SMCP language trainer. It is also possible to send an e-mail to the students, using the internal e-mail system.

**Show answers**

If the administrator/instructor clicks the “show answers” button, he/she will see all the correct and incorrect answers for the section that has been highlighted. The administrator will also see how much time the trainee spent on each question and whether he/she answered correctly the first time or not.

**Show graph**

![Figure 4.7 Show graph window](Figure 4.7 Show graph window)

*Source: MarineSoft*

The administrator/instructor is able to see, from the graph, how many questions were answered correctly in the first attempt, second attempt or later, and in how many attempts the answer facility has been used, simply by clicking the “show graph” button.
Transfer completed section

An advantage in using this software is the possibility to import a completed section done by a student to the database. That makes it possible for the student to work at home, or onboard, with a single user version, and still have the results in the server database.

![Transfer completed section window](image)

*Figure 4.8 Transfer completed section window*

*Source: MarineSoft*

From the author’s view, and his experience at sea and in using this program, it can solve language communication problems, which create one of the main hazards to safe navigation. Especially, as described earlier, nine of ten seafarers are non-native English speakers. Some people may argue that such phrases can be found in textbooks, even though the major problem is usually in the pronunciation of such phrases. This software concentrates on the pronunciation of the phrases rather than enforcing the users to know them by heart, which is impossible. Another benefit of this software is the possibility for all levels to use it, for example, masters, officers, pilots, VTS operators, and crew members. Furthermore, the user will be able to determine his/her progress through the evaluation system.
However, it may be boring for some users to listen to the same phrases in the same tone many times, when it is necessary to repeat the training many times. Also it examines and evaluates the ability of the users in using the correct phrases, but it does not solve the major problem: Has the user gained the ability to pronounce of these phrases correctly, or not? In addition, users have to have an advanced knowledge of English to understand the lengthy instructions of this program.

4.2.2 Shiphandling
The bridge team of today’s modern ships is exposed to a growing workload as a result of increased traffic and smaller time margins. This development is further emphasized through the introduction of larger ships to meet the demand for transport of larger cargo volumes. Knowledge about a ship’s manoeuvring characteristics is crucial for effective shiphandling and training of the crew. In many cases, incidents such as collision, ramming, and grounding can be traced back to manoeuvrability and controllability difficulties. Losses of life and material damage are definitely the worst to happen. Moreover, ship’s wrecking may also cause environmental damage due to oil and chemicals spills.

In many cases the transfer of knowledge and skill from the experienced masters to junior officers through on-the-job training is lacking. Few masters actively encourage their mates to handle their ships under supervision, but most masters still keep chief mates in the forward station during the manoeuvring operation (Hunt, 1997). Moreover, those chief mates who learn on the bridge from their masters or pilots should, as explained by Roberts (1997, p. 251) “… actively enquire from masters and pilots the reasons for their actions. Many of these professional will be only too willing to teach a junior officer who shows an active interest, though usually few will offer advice if this is not requested”. In addition, shiphandling, which is an essential element of seamanship, affects every operation, and yet it is only questioned when things go wrong. Masters and pilots say that shiphandling cannot be taught, it has to be learnt (Focus on shiphandling, 1996).
Thus, there is a need for a training system that allows junior officers to improve their proficiency in shiphandling in confined waters and in rough weather in open seas. Furthermore, the development of new specialized ship types operating at high speed and/or having unconventional steering systems emphasizes the need for training experienced masters. Familiarization training before taking the command in such vessels will therefore be very cost efficient. The first step to improve the officer’s quality in shiphandling is to assess his/her knowledge, understanding and skills in how to cope with the different functions of shiphandling. This should be compared with defined standards of competence derived from task analysis (Shiphandling Research…, 2002). International competence standards are presently being defined as part of the STCW 95 Convention to introduce a functional approach to education and training.

Moreover, the International Maritime Organization (IMO) is aware of the importance of proper procedures for shiphandling and introduced in 1994 the Interim standards for ship manoeuvrability. Examples of items found under the function “Navigation” are shown in Table 4.2, in which standards of competence, related methods for demonstrating competence and actual evaluation criteria are listed.

As a result, there is a need for developing and improving shiphandling skills and courses, through different methods of education, such as textbooks, PC-based training, full mission simulator, and ship models. As this thesis concentrates on CBT, an application of using computer-based simulation will be presented in the following section.

4.2.2.1 Simflex Navigator

Ship handling courses focus on manoeuvrability and operational limits of existing or new ships. In the PC-based simulations, environmental factors such as wind and current can be changed and slowly increased until the limits for harbor manoeuvr are reached. During the ship/ship interaction simulations, squat and bank effects can be
experienced for individual types of vessels. Simflex Navigator is designed to operate in both CBT mode and in part task mode. Exercises are running in either dynamic or static mode. While running in dynamic mode, the simulation acts as a part task trainer and own-ship moves according to forces imposed by the environment and manoeuvring actions performed by the officer or student in charge. The static mode is valuable for example while reviewing concepts of the rules of the road as well as many of the procedures for operating marine instruments.

Table 4.2 Example of competence for the sub-functions of “Navigation at the management level”

<table>
<thead>
<tr>
<th>Competence</th>
<th>Knowledge, understanding and proficiency</th>
<th>Methods for demonstrating competence</th>
<th>Criteria for evaluating competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manoeuvr, and handle a ship in all conditions.</td>
<td>Manoeuvring and handling a ship in all conditions including:</td>
<td>Examination and assessment of evidence obtained from one or more of the following:</td>
<td>All decisions concerning berthing and anchoring are based on a proper assessment of the ship’s manoeuvring and engine characteristics and the forces to be expected while berthed alongside or lying at anchor.</td>
</tr>
<tr>
<td></td>
<td>.1 manoeuvrs when approaching pilot stations...</td>
<td>.1 approved in service experience</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.2 handling ship in rivers.</td>
<td>.2 approved simulator training, where appropriate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.3 manoeuvring in shallow water, including the effect of squat.</td>
<td>.3 approved manned scale ship model, where appropriate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.4 interactions between passing ships.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.5 berthing and unberthing under various conditions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.6 ship and tug interaction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.7 management and handling of ships in heavy weather.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: STCW 95 (2001, p. 47)
**Simulator scaling**

Depending on the available hardware, a program training session can run on more than one computer connected through a network. Using this facility, several views are visible at one time. For example, the trainees can have electronic chart display visible on one computer, while the visual out-of-the-window-view or the ARPA is displayed on another one as well as the real control sticks for operating rudder and throttles. To optimize the outcome of the view, the program setup allows the out-of-the-window-view to be displayed using a workstation and/or using a projection screen. A good example of the simulator scaling is the network fitted at WMU, at which 8 computers are connected together. Each screen displays a part of the simulation scenario; electronic chart, radar, steering, navigational instruments, 3 screens for the out-of-the-window-view, and an instructor screen. In this network either static or dynamic scenarios can be displayed.

![Image of simulator scaling](image-url)

*Figure 4.9 Simulator scaling*

*Source: Simflex*
- **System configuration**

- **Minimum requirements**
  1. 500 MHz or faster Pentium II-III-IV processor or equivalent
  2. Windows NT workstation 4.0 or later with service pack 5 or later
  3. Internet explorer 4.x or later.
  4. 350 MB of free hard-disk (for local and server installations) plus space for saved exercises and exercise logs (> 20 MB).
  5. 64 MB RAM
  6. 3-D graphics accelerator (hardware accelerated).
  7. Software support for open GL.

- **Recommended requirements**
  1. 800 MHz or faster Pentium III-IV processor or equivalent.
  2. Windows NT workstation 4.0 or later with service pack 5 or later. or,
  3. Windows 2000 professional with service pack 1 or later.
  4. Internet explorer 5.x or later.
  5. 1 GB of free hard disk space (for local and server installations) plus space for saved exercises and exercise logs (>200 MB).
  6. 128 MB RAM or more.
  7. 3-D graphics card, 32 MB SGRAM, nVidia TNT2 or GeForce / GeForce 2 / GeForce 2 ultra chipset.
  8. Hardware support for OpenGL.

- **Start the program**

When the user runs the program simulation, the exercise browser will have focus allowing him/her to browse exercises and to select and run or replay an exercise. As this program is a multi-process system, each process simulates a major part of the ship or the bridge equipment. In addition, the user can switch among the bridge facilities and equipment, simply by pressing the buttons in the bridge task bar.
Shiphandling course

All exercises in the shiphandling course are placed in browser lists at the end of each chapter. The user can run or replay an exercise by selecting and clicking the right mouse button and select a relevant menu item.

Exercise browser

Using the dedicated exercise browser accesses all exercises, which are exposed when starting simulation. The browser consists of a directory tree, an exercise list, and a trainee record book. Figure 4.11 shows that when the user selects an exercise directory, either by clicking the tree view (far left), using the mouse, or by pressing the up or down keys on the keyboard, the tree view will have the focus. Moreover, if the user wants to expand or collapse the tree and see the contents of the selected directory node, he/she can do it by double clicking or pressing the “enter” key. The exercise list is updated when the selection in the directory tree changes.
Figure 4.11 Exercise browser

Source: Simflex

➢ Operating tugs

Figure 4.12 The tug control panel

Source: Simflex
When tugs have been included in a specific exercise, a tug operation panel can be used for controlling them.

- **Manoeuvring controls**

  Manoeuvre the ship by using the different equipment can be done with the mouse such as: Wheel, Rudder, and Throttles, unless the Simflex configuration is set-up with a manoeuvring handle box. The configuration of these controls is comparable to the real manoeuvring handles of the particular own ship.

- **Trainee record book**

  After exercises have been executed and logged, the log-file of each performance is listed in the trainee record book, which may be stored by date, name, exercise file name, or others. To change the sorting criteria click the column header.

  ![Trainee Record Book](image)

  *Figure 4.13 Trainee record book*

  *Source: Simflex*

- **Replay an exercise**

  If the user wants to replay an exercise, he/she can select a log file in the training record book and then press the replay button, thus log files will be created after exercises have been performed. Exercise lists have pop-up menus, which are activated by clicking the right button mouse button.
Assessment and documentation tool

After completion of a static or dynamic exercise, the results are stored in the student’s log and exercises as well as results can be assessed by the instructor on site or sent by e-mail for long distance learning. The student’s log is organized such that individual users of the same system will log on individually and thereby store results and exercises in individual logs that cannot be modified by the students. The replay system gives both the trainees and instructors a good basis for evaluating dynamic exercises.

There are many other good examples of PC-based simulation, which could be linked to classroom learning as listed by Fisher and Muirhead (2001, p. 49): “Officer of the watch (PC Maritime); ‘Navi-Trainer Expert’ (Transas Marine); ‘Mariner/Crisis’ stability (Baron & Dunworthy); ‘Portsim’ (SSPA); Marine Diesel Engines (Unitest); Marine Engineering (Marinesoft)”.

This software, from the author’s viewpoint, gives users the opportunity to train in shiphandling skills, which are very difficult to achieve through traditional teaching. Moreover, shiphandling skills are difficult to gain onboard ships due to reduction of crews, which results in masters and officers being very busy during manoeuvring as they do not have time for training. In addition, using a full mission simulator is costly and they need to attend such a course in MET institution, while PC based software enables users to train anytime and anywhere. Furthermore, the replay exercise function gives users the opportunity to gain the self-trust in his/her ability to manoeuvre the ship in all situations. The author’s believes that shiphandling skills may be gained through such software, simulator, or ship’s model, even though users still need practical training to be able to manoeuvre the ship.
Chapter 5

The computer in the at-sea environment

Formal education in marine science and technology is usually carried out in schools, colleges, and universities. Another important area is informal education, which is carried out via media, such as CBT and distance learning (Finerty, 2002). Both formal and informal education are facing a problem in the lack of delivering experience. In the former method, readers may think that lecturers have the required experience to deliver, but how long will it be before lecturers are out of date. For example, in the author’s workplace a junior lecturer has three years’ experience in teaching, which means he is away from sea experience for three years. In the second method, as explained in chapter three, CBT cannot deliver experience, a matter which is very important, especially for junior sea staff.

The last chapter presented two applications for using CBT as a learning tool, either in MET institutions, or onboard ships. This chapter illustrates the need for onboard training in general, followed by a discussion where the author examines the potential advantages and disadvantages of using CBT for onboard needs. Finally, an implementation issue for onboard training will be carried out to clarify the benefits gained from using CBT programs onboard.

5.1 An overview of training needs onboard

Seafarers are the heart of the maritime industry. No doubt, without them ships would not trade, cargoes would not be transferred, and the marine industry would collapse
However, an analysis of marine casualties indicates that eighty percent occur due to human error. Muirhead, (1994, p. 11.1) discusses this issue as:

Much criticism has been leveled in recent years at the lack of standards and skills displayed by many mariners at sea, and at the high incidence of human error as a causal factor in many casualties. It has also been stated at IMO and in other forums that many officers and seamen today lack the ability to perform tasks effectively in the workplace.

This lack of standards and skills is mostly due to lack of training, which can be carried out ashore or onboard. The Revised STCW Convention puts great emphasis on training and assessment to govern the qualifications required to operate specialized equipment, or to handle specific cargoes. Moreover, the ISM code, which now is included in the SOLAS Convention, also addresses the subject of crew training. It deals specifically with training in the safety management system, which includes the organization of emergency drills, and the familiarization training required for new crewmembers at the time of joining a ship.

The best way, from the author’s viewpoint, for achieving new skills is gained by having competent and experienced officers onboard. Those acting officers onboard have up-to-date knowledge, compared to lecturers who lose much of these skills as long as they are out of touch with the real world of shipping. However, lecturers try to encourage students to learn by possessing special skills, but these are more related to the academic discipline, and lacks the practice of the shipping companies’ corporate culture. On the other hand, senior officers have the ability to train and encourage seafaring cadets and crewmembers to gain the required skills to operate navigational and engine equipment, and to handle cargo in a more direct way than lecturers. Thus, depending on the senior sea staff, onboard training is the most beneficial for seafarers. This is clarified by Holder, (1997, p. 45) as:
The expertise and experience of senior staff are the most important resource available to you. In their own training and years of service, they will have had to deal with many different situations and will have gained experience, sometimes through making mistakes.

However, senior sea staff face some problems in training, such as lack of time, and fatigue. In addition, they also suffer from a fear of signing off a cadet’s record book, and then the cadet later proves to be incompetent.

5.1.1 Onboard training for seafaring cadets
Seafaring cadets may have their practical training onboard a training vessel, or onboard cargo vessels in shipping companies. First, they can get the training onboard a training ship, at which the academic learning is combined with sea experience. This will encourage them to gain more knowledge and experience, as they will be able to demonstrate whatever they learn practically, either on deck, or in the engine room. However, those training ships have nearly faded away due to commercial reasons. In developing countries, the problem may be a lack of funding due to getting low fees from students, which prohibits MET institutions raising capital to own a training ship. While in developed countries the fees are high, the problem is the lack of cadets themselves, which again creates a funding problem for MET institutions.

In contrast, there are some MET institutions that still own training ships. One developed country, for example is Japan, which owns many training ships, with the support of the government. Another example from developing countries is Egypt, where the Arab Academy for Science, Technology, and Maritime Transport owns a training ship, which is also supported by the government for commercial reasons. Cadets onboard such ships have traditional classrooms for learning the marine subjects, combined with demonstrations by trainers for these subjects. This is followed by practical implementation while the ship is berthing, and cadets are
usually able to implement action during a sea passage on the watch under the supervision of the Officer Of the Watch (OOW).

Second, seafaring cadets can be trained onboard cargo ships in shipping companies. The need for such training will be discussed in the next section. However, cadets face problems in this method as well. For example, lack of officers’ time, because most companies have reduced the number of crewmembers, while others have dual-purpose officers, with increased workload, which thus reduces the available time for training seafaring cadets.

5.1.2 Onboard training for crewmembers
The rapid development in technology at sea, in addition to the crewmembers and passengers own safety as well, creates the need for continuous training. In the past, seafarers were acquiring the necessary skills and knowledge for their professions by observing their seniors. That was acceptable for the old fashion ships, while nowadays they need to learn and train to cope with the modern technology onboard.

Moreover, they need to train because, as illustrated by Holder (1997, p. 5):

The effect of the ISM Code and STCW Convention on trainees at sea will be to make them more responsible for developing their practical skills and knowledge to the required level, and ensuring that they collect the required evidence to gain higher certificates of competency.

Thus, there is a need for improving the training methods to be more efficient, as stated by the representatives of public administrations, shipping company executives, and seafarers themselves in the Research and Development (R&D) project in Norway 1996 (Berg & Skotgard, 1996). These new methods can be carried out through using CBT programs and distance learning via satellite.
5.2 The role of CBT in onboard training

The need for improving training methods, as discussed earlier, challenges shipping companies to use CBT as a training tool onboard their ships. Shipping companies are looking to reduce costs in meeting the requirements of STCW 95 standards, and their specialized specific training. In addition, seafarers want to maximize their leave, and at the same time seek the training and standards required by their company and IMO regulations. This can be done through using approved CBT modules, and assessment can be carried out in MET institutions, as agreed in Norway, with Seagull products.

Furthermore, the advent of modern satellite technology opens the door to use network among ships and shore either in MET institutions, or shipping companies. Moreover, the wide use of the Internet and World Wide Web (WWW) assists in receiving the instructions from tutors, or training officers to crewmembers onboard. Tutors or training officers will be able to import crewmembers’ assessment to evaluate their progress. Thus, using such CBT modules will improve the quality of training, refresh and update existing skills, develop maintenance skills, monitor onboard training program, and assess the competence of trainees in practical skills (Muirhead, 1995). In short, CBT is a unique tool to cover parts of the training needs, while reducing the costs of others. It may help shipping companies to identify training needs and to identify seafarers who should not be on their ships at all.

5.3 The potential use of CBT for onboard needs

There are various specific advantages to be gained from CBT programs onboard, however there are also some disadvantages of using such programs. In this section the author will present, from his viewpoint, the most important advantages and disadvantages of using CBT onboard.
5.3.1 Potential advantages in using CBT onboard

1. CBT programs with built-in training and assessment sections enable shipping operators to comply with keeping training records. Such records will give the seafarer and the vessel the required evidence that the training has been performed. Moreover, keeping such records supports, under the ISM Code, the Safety Management System (SMS), ensures that such training is provided for all the personnel concerned. In addition, training records ensure that each ship is manned with qualified and certified seafarers in accordance with the national and international requirements.

2. CBT programs reduce the need for an instructor or supervisor onboard, as this involves self-learning. Seafaring cadets and crewmembers do not have to ask questions or seek repetition from the training officer onboard, but simply can repeat or replay that part at their own pace until they completely understand that section. However, some CBT courses may require a supervisor (trainer or senior officer) to support or enhance the CBT material by monitoring exercises, giving feedback, discussing problems, and so forth (Dean & Whitlock, 1988).

3. CBT is ideal where the processes to be mastered are hazardous, for example, the handling of explosives and dangerous cargoes, in general where training on the real equipment is prohibitive. An example of such a program is presented by Muirhead (1995) in using the onboard computer based Liquefied Natural Gas (LNG), as an interactive training program. This program was developed by a ship operator and teaching institution for crews of LNG ships in Australia. This program allows crewmembers to gain the required skills and procedures to deal with the cargo carried onboard without any risk for the cargo operations or ship’s safety.

4. CBT programs supported by distance education via satellite overcome the lack of access at sea of education and training by mariners (Muirhead, 1994).
Moreover, the development of satellite communications gives the opportunity to update the CBT programs frequently, which provides the marine industry with an option to pursue the goals of improved quality and standards of training. Furthermore, this combination, as stated by Muirhead, (1994, p. 11-2) “… open the window of learning and training opportunity to the mariner onboard the ship. The potential savings from spending less training time ashore in institutions and using the workplace more effectively to acquire knowledge and skills are considerable”.

5. CBT programs can be designed for multi-level training, so the same program is suitable for a range of target audiences or to let trainees progress to higher knowledge levels in controlled stages (Parker, 2000). The self-based nature of CBT (training and assessment) means that seafaring cadets and crewmembers with a higher level of initial knowledge can complete a program faster than those who are less knowledgeable, or those who are slow learners. However, each one of them should eventually complete such a program satisfactorily if they are capable of so doing.

6. CBT can be available at any time of the day or night; it is possible to make the training material available round the clock for different watches. For example, the chief mate who is looking for promotion, and the time is limited due to the workload, can get the required training in shiphandling PC-based simulation in his free time.

7. There is a lack of formal training in personnel management in marine science, which is the major part of the master’s job. Thus, masters are depending upon their personnel skills, which may be improved by experience. However, Roberts (1997) asks a question: Does a master mariner’s certificate of competency qualify its holder to command a ship? The answer to this question, according to Roberts, is no, or at best partially.
The writer agrees with him, indeed the CBT courses in management either for crowd management onboard Roll-On / Roll-Off (Ro/Ro) passenger vessels, or crew management in emergency situations, are able to provide them with the required experience, in addition to their experience in command, to act also as a manager of the ship. In short, shipping companies and seafarers can benefit when they correctly implement and monitor computer/based training and assessment in many areas. For example:

- Computer-based assessment is an efficient method to monitor that seafarers do the required training; it also provides the records needed by the company to demonstrate compliance.
- Computer-based training is particularly good for individual learning and will be of good help for those who are motivated to improve and/or prepare themselves for promotion.
- Identification of training needs can be performed onboard by means of computer-based assessment and should be an integrated part of the overall training and assessment plan.
- It is a unique method of teaching the knowledge of rules, details of equipment, processes and safety procedures, which need to be committed to memory. Judging from the way port state and vetting inspections are carried out, this may help ship owners reduce the risk of penalties and difficulties with charterers.

5.3.2 Potential disadvantages of using CBT onboard

1. The major limitation on using CBT onboard is the need for technical support of the relevant hardware. This is logical when different ships with varying knowledge and experience contain CBT programs on computers with a number of different configurations, as there will be technical problems, and the ship will need support. Even if all the programs are based on the same programming platform, or only require a web browser, some computers will need to be supported because of the nature of computers today. Moreover, this support should be quick and reliable, and must be performed without detaining the ship.
Parker (2000, p. 63) supports this idea and states, “computer equipment and software can have compatibility problems and some means of providing user support is required”.

2. The second major limitation of CBT that it is not reality, but is just a part of it, reality is much more complex and far more unpredictable than a simulated world can ever be (Hensen, 1999). He adds, “It is important, however, to be aware of the degree of fidelity of the simulation and how it influences results, unparticular when safety margins are small.” Indeed, the author agrees with this opinion, but there is an advantage from using CBT onboard as the trainee will be able to implement whatever he/she learns from such a program practically onboard. For example, if a chief mate uses a shiphandling program for berthing the ship in specific conditions, the master of the ship may allow him to take over the berthing manoeuvre under his supervision.

3. CBT programs depend upon self-based learning. As most participants have not learned in this way before, they may feel uncomfortable with learning on their own. This problem may be clearer in countries which depend upon spoon feeding in learning. From the author’s experience in teaching in developing countries, seafaring cadets, and indeed crewmembers are not so familiar with self-based learning; they prefer to attend a traditional classroom and get the knowledge without the need to collect data or information. Thus such students may encounter difficulties in using such programs.

4. Language may be considered as another limitation. As discussed in chapter two, most CBT programs start with an introductory section, which usually requires reading skills. The common language used in most programs is English, which is not the language for the majority of crewmembers, especially ratings. Thus, they will not be able to read the instructions, indeed they will need an interpreter (usually a certified officer) to explain how to run the program. However, even
when training materials are translated, care must be taken, as Parker (2000, p. 6.3) says: “To ensure that the intended message does not become changed through the translation process, which poses a significant risk”.

5. CBT programs cannot deliver experience, as discussed earlier in chapter four. As a result seafaring cadets and crewmembers must still seek experience from senior sea staff.

6. Trainees cannot ask computer questions in the event of misunderstandings or difficult situations, and so are limited to the pre-determined help facilities designed into the training course (Janardhanan & Chawla, 2001). Thus, trainees will have to look for answers to their questions from the experts and experienced senior sea staff onboard.

7. Some CBT programs contain over-impressive graphics and animations, which may detract trainees from achieving the specified learning objectives. For example, a shiphandling course in approaching port, may take the attention of the trainees to the port facilities, rather than concentration on the manoeuvring procedures.

The last section discusses the potential use of CBT onboard, however another area the author wishes to raise is that of cost. Some people believe that not everything can be quantified, nevertheless everything can be measured. Certain soft skills, such as leadership, may be more difficult, but they can nonetheless be quantified. Thus, to discuss the costs of CBT programs, benefits from using such programs should be considered, Gery (1987, p. 198) argues that:

CBT is both computer software and a training program, and it cannot be judged solely on a single set of criteria. Too many organizations make the mistake of
leaving CBT evaluation in the hands of either the content experts, the trainers, or the learners when none of them can do an adequate job alone.

From Parker’s viewpoint (2000, p. 6.9) as an expert he says that: “developing computer-based training is expensive in terms of man hours. Depending upon the complexity of the program, a typical cost can be between £1000 and £5000 per minute to produce”. However, Seagull as a producer of CBT packages says that CBT is an extremely cost efficient training method when developed in the right format and combined with other forms of training such as on-the-job training, practical exercises and shore-based training and education. Previous arguments clarify that there are many different views to judge whether CBT programs are expensive or not. The author believes that there are many different methods for onboard training, such as traditional training, and using CBT. Of course, the traditional method is cheaper than using CBT programs, as shipping companies do not have to pay either for equipment or software.

However, the benefits of using such programs are very difficult to achieve by the former method. Records enable shipping companies to follow the progress of their seafarers even if they change ships, so they can trace them for the long term. Seafaring cadets and crewmembers will benefit from using computer-based assessment to save training time, and determine their progress. In conclusion, CBT program costs are considered reasonable, if the judgement is carried out regarding the benefits gained from using such programs. Moreover, economies of scale resulting from the growing amount of use of CBT programs, together with the use of Internet and e-mail, the costs of these programs will be reduced.

5.4 Implementation of CBT programs onboard

Even though CBT has been in use for decades in many industries and has been talked about for many years in the marine industry, it is a new tool for training seafarers. A few shipping companies implement CBT programs onboard their ships, such as Red
Band (which is the management company of Fred Olsen), who have been using CBT modules since 1994. First, the author would like to present the specifications of such programs from his viewpoint, and a producer’s (Seagull) view:

- Training programs which are delivered to ships in physical media such as CD-ROM, portable hard disks, or similar media. This is cheaper, so far, than downloading or accessing the programs via the Internet from ships.
- Programs that can run on a three-years’ old personal computer; they must be interactive and entertaining.
- Training programs should be self-based training without the need for any support from instructors or senior sea staff onboard.
- Training programs must have built-in assessment and produce credible training record keeping requirements of the STCW Convention and ISM Code.

![Figure 5.1 CBT library (Seagull)](Source: Seagull)
The first two CBT system installations took place on two Suez max tankers operated by the above mentioned company in November 1994. Each system consisted of a 486 PC with CD-ROM and six CBT modules (Berg & Skotgard, 1996). Each module, which could be chosen from the menu, consisted of:

1. A definition of the learning objectives.
2. A multimedia learning section, this section is always divided into relatively short chapters in order to motivate the seafarers’ progress.
3. An assessment part, most often based on multiple-choice questions.
4. A record providing, in detail, documentation of how much of the training has been performed, and the score achieved in the assessment.

These modules are the ingredients of the training library, or what is called onboard library, figure 5.1, which is based on the revised STCW 95 Convention.

![Training Library](image)

**Figure 5.2 Training Library**

*Source: Seagull*
Training library “onboard library”
This is a program, which gives an overview of the CBT modules, and is used to provide an automatic start to the modules (figure 5.2), so that there is no need to use complicated codes to start the programs. The seafarer can start the training library program, and insert the actual CBT module into the CD drive and select the title from the menu.

Training administrator
This is a program, which takes care of the recording and storing of the training records from the CBT modules. The advent of this program is that, it may also be used in a shipping company to keep a central record of all training reports from all ships in its fleet.

Figure 5.3 Training Administrator
Source: Seagull
Computer Evaluation System (CES)

This is a computer-based evaluation tool that consists of a large database of questions, mostly multiple-choice, for use in assessing the knowledge of seafarers. This program does not need any computer or typing skills, and it presents the results immediately.

![Computer Evaluation System (CES)](source: Seagull)

In conclusion, using such programs onboard will improve the training, especially on ships with few crewmembers and limited available time for group training. These programs overcome the problem of training the trainers, raised by Holder (1997, p. 4), that “A few training officers may qualify as specialist trainers or assessors, in which case they will need to be properly trained for their new role”. Thus, shipping
companies, by using such an onboard library, will not have to have trainers onboard. Moreover, these programs do not require any specific skills in computer science; the user must be able to read, or understand the description of instruments and equipment, and be able to use the mouse to move through the chapters, or to answer the questions. In addition, using the records for each seafarer, with the export system, will enable the training officer in the company to have a full picture of all crewmembers and their progress.
Chapter 6
Conclusions

In the early 1960s, under the guidance and endorsement of behavioral psychologists, the idea of a personal teaching machine emerged and became the embodiment of one view of the future of education. These machines were originally simply drill and practice or tutorial programs, in a book or in a cardboard box with a window, which guided students through the lessons. Eventually, large systems of so-called Computer Assisted Instruction (CAI) were implemented in elaborate systems like PLATO (Programmed Logic for Automated Teaching Operation), developed at the University of Illinois, and TICCIT (Time-shared Interactive Computer-Controlled Information Television), which offered an extensive library of programs stored in large mainframe computers.

This study has revealed that in typical drill and practice CBT programs, students are presented with cases reflecting a sequence of skills and requisite sub skills to be practised. In the most sophisticated forms, drill and practice programs contain elaborate branching routines, based on the individual student’s responses, which present the appropriate cases. In contrast, tutorials usually attempt to teach new information and new conceptual understandings. A typical tutorial CBT program starts by presenting information and follows with a series of questions that guide the student to an understanding of the information and ideas presented. When students successfully answer questions more information is presented; when students are successful in responding to questions, either a hint or repetition of previously stated details is given, followed by more questions.
Moreover, tutorial programs are usually more sophisticated than drill and practice programs. Although tutorials are certainly not one-to-one human dialogues, most have built in responses to sets of anticipated correct and incorrect student answers. To narrow the range of these answers, many tutorials employ a multiple-choice format in their questions. Some programs combine drill and practice and tutorial with a management system. As the student progresses through the skill sequences, the computer monitors records that can be transformed into detailed reports for the teacher and students. Three essential assumptions are at the heart of all drill and practice and tutorial programs: first, that basic skills are learned like physical skills through repeated practice; second, that more complex ideas and skills can be learned by being broken down for the student into appropriate sequences of sub-ideas and sub-skills; and third, that students will replicate behavior that is reinforced with a pleasant experience.

Like tutorials and drill and practice, simulation, as an instructional application of the computer, began on mainframes in the 1960s. Since many relationships are complicated and their outcomes often unpredictable, the simulation program produces a problem-solving situation in which decisions are made in the light of past experiences and projected into the future. One critical consideration for the teacher is the number of variables that are included in a simulation, since most simulation programs are limited in scope and complexity.

Another teaching method via computer is educational games, where games can be recognized as potential learning situations for the players, who must begin to think in terms of survival, what techniques help them to stay alive, to score well, or to win a free game. The game presents a finite manageable fantasy world in which players have control, where there is a clear goal, and where, in spite of rapidly changing environments, players have the possibility of success within the reach of each finger.
This study answers the questions in the first chapter as follows:

- **What is CBT? And, what are its methodologies today?**

  The results of examining different definitions, as shown in chapter 2, from users and producers showed that CBT is interactive training using the computer as the delivery medium. The usage of multimedia i.e. the integration of text, photos, graphics, animation, sound, and FMV creates a dynamic communication environment for the student. CBT courses can be instructor-led, self-based, or combination of both. Moreover, the current methodologies, as shown in figure 1.1, (tutorial, drills, simulation, games, and assessment) are discussed earlier in this chapter.

- **Are there differences between using CBT and traditional methods? If so, what are the challenges of CBT for teachers and students?**

  CBT as a teaching/learning tool has benefits over using traditional methods for both students and teachers. Students benefit from using CBT, for example, instead of a textbook, so they can cover a lot of material with this simple CBT program without the need to look for such books in the library, or waiting in a long queue for a copy. In addition, simulation in MET, and onboard as well, is very important to train seafaring cadets and crewmembers. However, a simulator is costly and difficult to implement onboard, where as using a computer-based simulation is the solution to this problem.

  Furthermore, via distance, CBT can be used in connection with the Internet within shipping companies or MET institutions to download programs onboard, or update existing programs to improve the efficiency of the crew, and get feedback to evaluate their progress. On the other hand, teachers also benefit from using CBT programs; for example database and spreadsheet programs help teachers to manage and manipulate any information with certain important aspects dealing with certain data or tasks to perform. Moreover, teachers become
more effective since trainees/students will have more time to devote to supervision and counseling.

- What are the potential applications of CBT on MET?
  There are several applications of using CBT in MET, such as communications, Maritime English, navigation, shiphandling, and engine room applications. The previously mentioned research by Muirhead (2001) showed that the intentions of MET institutions up to the year 2005, in a global survey, indicate a general desire to create CBT laboratories with modern PC-based equipment. In addition, the writer of this study provides two examples of CBT applications and their implementation in MET institutions.

- What are the potential uses of CBT onboard ships?
  The skill of training seafaring cadets and crewmembers is a valuable issue. This study proposes and demonstrates one approach to onboard training, which is the use of CBT. CBT programs afford the trainee the freedom to learn at his/her own pace, at a location of his/her choice, and at a fraction of the cost, as discussed earlier, related to the benefit gained.

In summing up, the writer of the view that the key issues that will impact upon the growth in the use of CBT are:
1. reduce the total cost of training
2. require less time for training
3. standardize the quality of the training
4. improve the effectiveness of learning.
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