

P r o c e e d i n g s
16th IAMU Annual General Assembly
Opatija, Croatia, 2015



Sveučilište u Rijeci
Pomorski fakultet Rijeka
University of Rijeka
Faculty of Maritime
Studies Rijeka



IAMU

International Association of Maritime Universities

DISTANCE DELIVERY OF IMO STCW COMPETENCY COURSES Making the Concept a Reality through Modern Technologies and Learning Tools

Lokuketagoda, Gamini*; Ranmuthugala, Dev; Jayasinghe, Shantha

Australian Maritime College,
University of Tasmania
Australia

Abstract. Maritime Education and Training (MET) is relatively complex compared to traditional education and training systems mainly due to space and time constraints experienced by seafarers. In addition, the diversity of the seafarers' educational backgrounds, field experience, and competence make MET even more challenging. Therefore, the traditional, fixed-term, college based education systems are not always the most suited for seafarers to develop their competence to meet the needs of the industry.

With the advancements in Information and Communication Technology (ICT) distance learning, especially targeting seafarers at sea is becoming an attractive alternative in MET. In recent times, advanced software programs, simulation tools, and associated hardware enable multi-mode distance learning options ranging from passive delivery of material to interactive audio-visual sessions. These tools have enabled education institutions to package and deliver a range of programmes, including those traditionally considered as 'must attend' within regulated Certificate of Competency (CoC) courses, thus providing the flexibility that complements the life style of modern seafarers, as well as promoting self-directed and self-paced learning.

These advantages come with challenges such as the extensive efforts required in the development of: content, appropriate facilities, suitable assessment strategies, and channels of communication and feedback. The location and time separation between the instructors and students often hinders effective communication, which can be exacerbated if appropriate support is not arranged in advance with the ship owners and operators for the deployment and continuation of distance delivery programmes. These challenges need careful handling to ensure distance delivery of IMO STCW competence courses becomes a reality.

An example, specific to the Australian context, on the successful delivery of distance learning is the Math-Primer programme developed by the authors that uses modern ICT facilities to prepare students with the necessary background in mathematics irrespective of their location or educational background. This programme has grown in popularity across disciplines, with evidence clearly showing significant improvement of student competence and satisfaction. This paper outlines how the authors effectively used modern ICT to develop and deliver this programme through a blended delivery mode. In addition, lessons learnt in implementing this programme, associated challenges, and possible solutions are also discussed.

Key words: assessments, distance learning, IMO STCW competencies, seafarer, web based learning

***Corresponding author**

Phone: +61 3 6324 9657

e-mail: Lokuketagoda@utas.edu.au

1 INTRODUCTION

In recent years, it is observed that there is a continually growing interest and demand for the distance and/or blended delivery of seafarer qualifications; especially those conforming to the International Convention on Standards of Training, Certification and Watchkeeping (STCW) as stipulated by the International Maritime Organisation (IMO). The push for such options both within the seafaring community and vis-a-vis Maritime Education and Training (MET) institutions is two folds. The first is the economic and time constraints faced by the seafarers and their employers in adhering to the traditional college based education [1]. This is compounded by the limited number of MET institutions available across the world, their geographical locations, and the scheduling of the programme that can make attendance challenging, especially in light of demanding and changing shipping schedules and the scattered global catchment areas for seafarers. Although many MET institutions attempt to accommodate the scheduling of the employers, it is not possible to meet the varying demands from a range of employers each with differing requirements nor is it always possible to marry the needs of the shipping industry with the educational cycles of different jurisdictions. This has created a strong demand for changes and options for the current MET models that can be customized and fit into the working life cycle of seafarers without causing undue disturbance to their or that of their employers' schedules.

The second factor influencing distance delivery is the recent advancements of Information and Communication Technology (ICT) based distance learning methods, which have created platforms that can customise and enhance the delivery of MET programmes beyond the traditional boundaries. The growing use of ICT based blended learning methods and programmes within the wider tertiary educational industry has been one of the drivers motivating MET institutions to adopt them and develop customised delivery options for IMO STCW competency courses.

2 FACTORS INFLUENCING DISTANCE LEARNING

The advantages of distance delivery come with associated challenges. Some of these challenges are the extensive efforts required in developing content suitable for distance delivery, arranging appropriate facilities, developing appropriate assessment strategies, and ensuring channels for communication and feedback [2,3,4]. The development of content suitable for distance delivery is a major challenge for MET institutions, as it not only requires significant amount of re-

source allocation but also a change in the way of thinking about the delivery of material and the attainment of competence. Some of the important factors that must be considered when developing content for distance delivery are:

- targeted competencies and outcomes;
- profiles of the different learning cohorts and their requirements and limitations;
- understanding the impediments to the learning;
- presentation of the learning material to enable the students to attain the required competence, as the structure and format of the material and the methodology of delivering, as it plays an important role in scaffolding the learning to meet the stipulated competencies;
- time and cost of developing the learning resources and the availability and access to the associated systems to deliver them;
- ease of making the resources available to students and available support infrastructure and systems; and
- ease of ongoing access, follow up of lessons and feedback.

Traditionally, most distance learning material consists of course notes, worked examples, and support resources which are in the form of printed material. With the development of ICT, traditional paper based distance learning is being supplemented, and indeed replaced, with electronic based material. An immediate advantage of this shift is the replacement of 'volumes' of hard copies to distant learners with electronic material through vehicles such as the internet, data clouds, or simply on a USB drive, the latter overcoming issues of access by students to the internet. However, blended delivery is more than just sending the material in electronic form, it has to develop methods to enable students to engage and interact with the curriculum to help understand concepts, gain skills, and attain the required competence. The first step is supplementing the electronic notes with relevant audio-visuals and animations to promote engagement and enhance the learning.

The growth and advancement in ICT have made it possible to record lectures, tutorials, and laboratory experiments and make them available to students as media files across a range of formats, something that was not possible with the traditional paper based distance delivery system. However, recording and editing the electronic material to: promote engagement, meet professional standards, enhance learning, and enable easy access is no small task, requiring considerable amount of effort, time, resources, and knowledge to

achieve the objectives. Badly made and unsuitable material and tools may drive students away, rather than promote learning. On average, each lesson requires extensive preparation by the facilitator, including the design, recording and editing of the audio-visual material to eliminate mistakes, target outcomes, and importantly make it interesting and engaging. This may require the use of professional technical staff, such as cameramen and audio-visual technicians, to ensure that the recordings are at the right quality and standard. This unfortunately can result in an upward spiral in cost and time, making the programme unviable. Thus, it is important to work out a balance on what can be achieved, carrying out a cost-benefit analysis that will provide the required outcomes within the available resources and time frame. Although compromise is important to achieve this, developers and managers must never lose focus on the outcomes and how they can be achieved. Thus, it is important to return to the factors that should be considered when developing content for distance delivery, identified at the beginning of this section.

In addition to the content development, arranging necessary facilities such as ICT infrastructure and systems, and staff training are other challenge faced by MET institutions. The latter can be across a number of areas, such as the use of ICT equipment, developing curriculum and material for blended delivery and assessment, managing distance programmes, etc. Many embark on the development process without the required skills and resources, which unfortunately results in substandard programmes that fail to meet stakeholder requirements and in the worst case abandonment.

Delivery of material is one aspect of a distance programme, as it has to be matched by assessments. Academic staff must develop appropriate assessment strategies that would reflect the true level of achievement of intended learning outcomes to ensure that the students have attained the required competence [1, 2]. The traditional approach of giving assessments to students and evaluating their submissions may not be optimal for blended delivery and assessment. While this gives an overall indication of students achievements, improvements can be made through web based tests and interactive assessment techniques [4]. Other issues that need consideration when developing assessment material and strategies include: ability for the student cohort to complete the tasks, feedback methods and timing, plagiarism, frequency, links to learning, suitability and link to learning outcomes and competencies, availability, equity, regulations, etc.

The location and time separation between the instructors and students often hinders effective communication, which can be exacerbated if appropriate support is not arranged in advance with the ship own-

ers and operators for the deployment and continuation of distance delivery programs [5]. Therefore, creating and maintaining appropriate communication channels that suit both instructors and students are essential for the successful delivery of IMO STCW competency courses online [5, 6].

From the seafarer's point of view the successful receiving of the intended learning outcomes heavily depends on:

- how well the materials are packaged and presented;
- whether the seafarer has the required minimum educational background, knowledge, and skills to engage with and gain from the programme;
- availability of time to study while working on-board, or on rostered leave (which requires support and understanding from the employer and senior staff); and
- support from the MET institution, including availability of a facilitator/instructor, online assistance, quick turnaround, and feedback.

3 DISTANCE LEARNING REQUIREMENT AT AMC

The Australian Maritime College (AMC), an institution of the University of Tasmania, offers a wide range of maritime educational and training programmes ranging from certificates to post graduate degrees across a wide spectrum of maritime fields coupled with innovative and adaptive attitude which is in many ways is unique to the Australian Mariner, to differentiate themselves from the world market [7]. The Bachelor of Applied Science (Marine Engineering) provides marine engineers on ocean going ships training pathways from pre-sea to management level Certificates of Competency. It is structured to meet the requirements of new entrants to the industry as well as existing seafarers wishing to upgrade their marine engineering qualifications. Two exit points allow students to return to sea after completing their operational and management level qualifications. The two entry pathways to the programme are shown in Figure 1.

Entry requirements for grade 12 school leavers ensure that new entrants through this pathway meet the minimum mathematics requirement as stipulated by the AMC, that they are able to cope with academic content within the programme. However, students who have completed non-marine trade studies (usually through an apprenticeship that usually has very little academic, and specifically mathematical, content) are also admitted and are granted advanced standing in a number of practically oriented modules. However, a major challenge faced by them (and the instructors) is to successfully complete units within the degree pro-

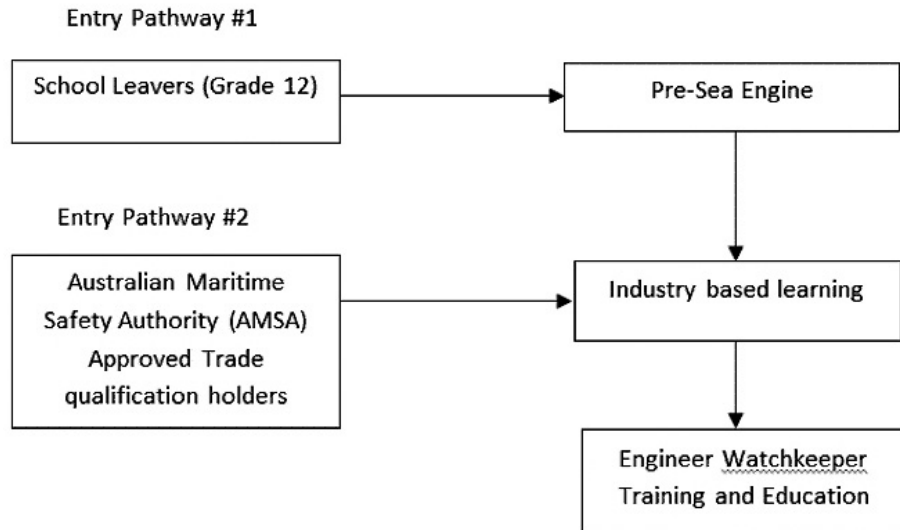


Figure 1 Entry pathways for the Bachelor of Applied Science (Marine Engineering) stream at AMC

gramme that require a reasonable background in mathematics and science. This is compounded as students from both pathways sit in the same class with significantly different mathematical capability, presenting both the staff and the students with a number of challenges to engage with the content and achieve the required competence in a relatively short time span dictated by industry schedules.

In an attempt to assist these students a number of approaches were employed for several years with a relatively low rate of success. These included providing students having lower than required mathematical knowledge with: additional classes, peer assistance, improved learner's guides, remedial tutorials, etc. However, it was clear from a number of student interviews and information sessions with focus groups that these actions were retrospective; addressing the issues after students commenced their study rather than providing them with the necessary knowledge and skills for success at the commencement of the programme.

In order to address this issue, students with lower than required mathematical knowledge were advised to undertake a Mathematics Foundation units [8], provided by the University of Tasmania and delivered online. Thus, theoretically they could access and complete the programme while at sea completing their 'industry based learning' phase shown in Figure 1. This foundation course delivered through video recorded lectures made available through a web portal. Students were also provided learning material with embedded assessments.

However, this option did not provide an acceptable and convenient solution for most of the students as there were issues related to: difficulties in accessing material on the web especially large video files, inability

to access the web at the required times for question and feedback while serving at sea, limited internet availability on some ships, differences between employers and employees linked to study time on ships, and inability to obtain support when required.

Further investigations into the requirements of the student cohorts, again through interviews and focus group sessions revealed that the students did not engage effectively with a distance delivery approach for mathematics or science consisting of learning from text books or watching recorded class room lectures. They also wanted the information in 'bite-size chunks' that the recorded lecture in the foundation units was unable, to facilitate. They required short, focused, and clear delivery of information using relevant and simple audio-video presentations that reinforces the key concepts and provides understanding of the processes that many found difficult to relate and remember.

4 MATHEMATICS PRIMER

With the abovementioned finding in mind, a blended delivery approach was developed for the delivery of mathematics for marine engineering students requiring to build basic mathematical concepts prior to, and during, their Certificate of Competency (CoC) courses, which was titled 'Mathematics Primer'. The first step was to identify the areas of mathematics that needed addressing. By reviewing the past formative and summative assessment results, areas within the mathematics curriculum that affected units requiring prior mathematical knowledge it was possible to identify 'critical gaps' that prevented students attaining the required competence. This was triangulated using a series of in-

interviews with past, present, and incoming students as well as instructors, educational developers, and employers. Once the gaps were confirmed, a structure was developed taking into consideration the student requirements, constraints, and available technology to deliver the required content and competencies.

The first step was the development of a mathematics learner’s guide to explain the basic concepts in simple details, with the areas of the curriculum broken into smaller manageable sections (i.e. the required bite-size chunks), sufficient examples and detailed logical processes. Using this learner’s guide as a structural guide, separate audio-visual recordings were made for each section using a document camera. These recordings provided students guidance on progressing through the different concepts and problems, clearly describing the approach and process. Used together with the learner’s guide students are able to focus on specific concepts and gradually develop their knowledge and skills to solve problems. During the preparation for recording, special care was taken to make sure that the recordings were short, focused on the subject matter, and presented in a simple format and language.

The Mathematics Primer programme commonly referred to as Maths Primer comprises of the learner’s

guide, linked work book, and 22 media files with a total media file time of about 8 hours. All of the above material was made available to students as electronic files copied onto a USB drive, thus addressing the issue of the unavailability or limited availability of internet on-board ships. The work book is provided with answers for all examples and tutorials except for the final assessment, which the students are expected to attempt and submit to the facilitator/instructor for marking enabling AMC and the students to determine their mathematical level at the end of the programme.

Students were instructed to follow the lessons in the learner’s guide in conjunction with the relevant media files. The instructors in the media files take the students logically and systematically through the concepts and exercises in the learner’s guide book providing a substitute to that the students would have experienced in a traditional a class room situation. There are sufficient worked examples which help students understand the concepts and practice them to gain familiarisation. A drawback to this approach is the absence of interaction with the teacher that would have been present in a real class room situation. On the positive side, the students can replay a media clip or a portion of it, any number of times until they grasp the

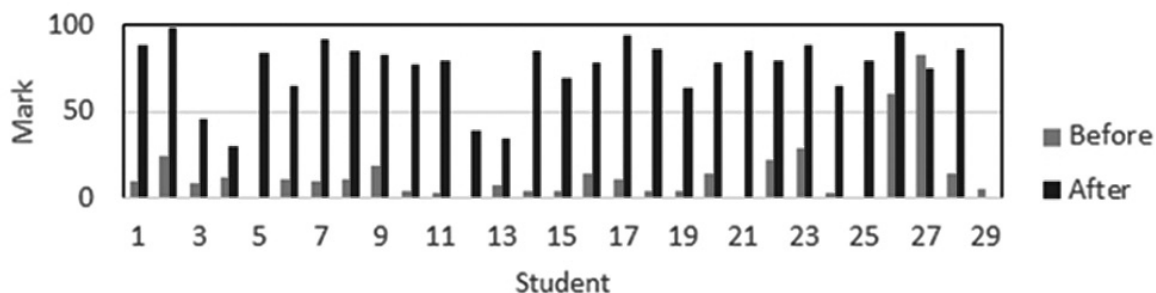


Figure 2 Marks obtained by students in the mathematics tests before and after completing the Maths Primer programme

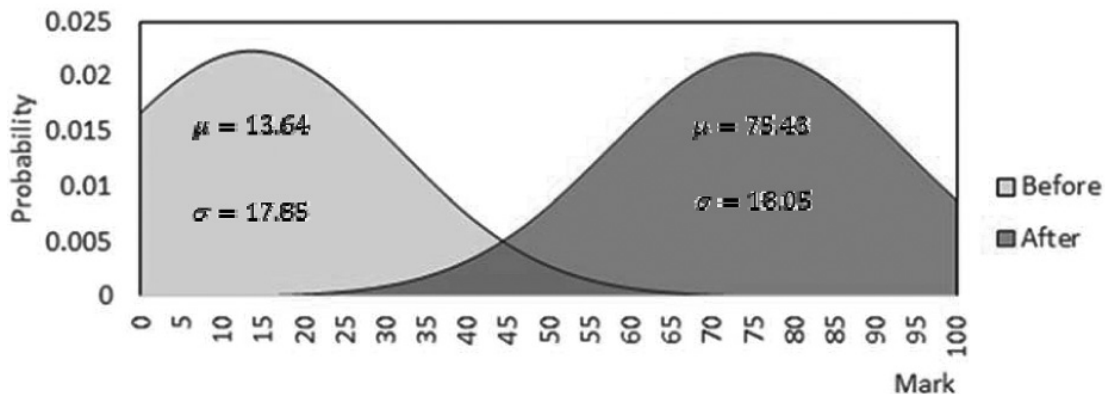


Figure 3 Probability density functions derived from the mathematics marks obtained by students before and after completing the Maths Primer programme

concepts. Tutorials were also conducted in a similar manner. The students learn at their own pace and time, which is not always the case in a class room lecture, where they are compelled to follow at the pace of the lecture. It is evident from student feedback that this has been a strong reason for students to accept and embrace this mode of learning.

The effectiveness of the Maths Primer programme launched in January 2014 was examined by pre and post testing of a cohort of marine engineer watchkeeper students. All students of the cohort were given a pre-test, i.e. a mathematical test before embarking on their studies. They were then given the Maths Primer package and one week of self-study. At the end of the mathematics self-study programme the students were again tested, i.e. the post programme test. The results from the two tests for each student who followed the Maths Primer programme are shown in Figure 2, which shows that there is a significant improvement in students' performance after taking the Maths Primer course.

In order to analyse the results further, the normal distribution of the two sets of results were obtained and plotted as shown in Figure 3.

The statistical parameters mean (μ) and standard deviation (σ) of the two distributions are also shown in the same figure. There is a 5.5 times increase in the class average mark, which show a significant improvement in the students' mathematical knowledge after taking the Maths primer course. Another important point to note is that the standard deviation of the two distributions, in other words the spread of marks, doesn't show a significant change. This can be interpreted as an overall improvement in the mathematics knowledge in the class and that it has affected every student in a similar way.

Following the positive results from the delivery of Maths Primer in early 2014 its delivery has continued throughout the year, with student satisfaction recorded at 83% amongst marine engineering students, much higher than comparative class room delivered programmes. It has subsequently been extended to students following navigation courses by developing a 'Navigator's Maths Primer' targeting their specific requirements. Navigators' Maths Primer recorded a high satisfaction rate of 85%. The followings are extracts from the feedback received in surveys designed to test the effectiveness of the programme:

"Challenging... rewarding... refreshed past knowledge... good introduction... like having a private tutor... broadened understanding... liked the self-pace approach...encourage students to take a copy on-board as it will help us in work... helped background math and improved understanding... easy to follow."

In addition, 98% of the students recommended that the Maths Primer programme be given to all the students joining seafaring courses at AMC.

Presently the students who wish to join AMC for marine engineer watchkeeper CoC courses are encouraged to undertake an aptitude test available on the website. Students faring below a designated threshold in this test are required to complete the Maths Primer before joining the marine engineer watchkeeper programme, thus providing them with the required knowledge to confidently take on the academic rigors of the course.

5 FURTHER DEVELOPMENTS IN DISTANCE LEARNING

The success of Maths Primer programme has encouraged the authors to develop the Marine Mathematics unit, an integral part of the marine engineer watchkeeper CoC to be offered as a distance delivery unit. The unit is currently undergoing a pilot delivery programme that will provide further information on the suitability of method and required improvements. Further the preparations are underway to develop a related unit within the same course, i.e. Theoretical Marine Engineering, which will follow a similar delivery pattern. Currently the materials including the audio-visual are being prepared. An important lesson learnt from this work is that once the delivery format has been developed and the content identified based on the required competencies, outcomes, and a gap analysis, the development of the material should start with a learner's guide that suits the targeted audience and meets their expectations and capabilities.. Experience in the seafaring industry shows that this should be done in bite-size chunks, with simple explanations, and problems and examples solved in logically and systematically. Modern ICT equipment such as document cameras, video capture and editing equipment, and animations provide the developer with a range of options to create a student friendly learning environment, although staff will need training and patience to master their use, remembering such equipment offers the advantage of 'repetition until perfection'. Some equipment and systems may also need expert intervention to ensure quality and effectiveness.

6 CONCLUSION

The paper describes the use of modern ICT equipment to develop distance delivery options to transfer technical and academic content to seafarers through

blended delivery programmes, enabling them to engage positively and attain the required competence. A pilot project in pre course mathematics was analysed with student feedback and achievements clearly showing significant improvement in the knowledge.

As the technology advances and the cost of recording devices and associated software drops, it is a matter of time before quality media clips can be produced by lecturers without incurring very high costs or effort. The advantage with the use of ICT equipment such as document cameras are that they can capture animations, power point slides, white board information, and real life demonstrations all at the same time without much cost. With such technology at our fingertips, it is inevitable that future students will move further away from traditional face-to-face contact time in MET institutions. Although the latter will yet remain a part of the training, blended training options utilising innovative techniques and modern technology will increase and possibly form the core of the training in the future.

REFERENCES

- [1] David Dearsley et. al., "ECSA, ETF report on maritime career path mapping". Available online at <http://www.ecsa.eu/projects/career-mapping-project>, accessed on 13th March 2015.
- [2] Tomei, Lawrence A, "Learning Tools and Teaching Approaches through ICT Advancements" IGI Global, Aug. 2012.
- [3] Tanzer Satir, Cengiz Deniz, "Distance Learning at the Turkish Maritime Education" Proceedings of the 15th Annual general assembly of the International Association of Maritime Universities, pp. 264-270. 27-30 October 2014.
- [4] John Cross, John Tucker "Application of the Keller Plan to Marine Education in the 21st Century" Proceedings of the 15th Annual general assembly of the International Association of Maritime Universities, pp. 36-45. 27-30 October 2014.
- [5] Hirimbure, S and Lutzhoft, M, "Distance education for seafarer students: Survey of seafaring community", Proceedings of the 15th Annual general assembly International Association of Maritime Universities - Innovation in Maritime Education, Training and Research, , Australian Maritime College, Launceston, Tasmania, pp. 285-294. 27-30 October 2014.
- [6] John Cross, John Tucker, "Towards the Creation of a Formal, Auditable Standard for the Delivery of Distance Learning and E-Learning Programs for Mariners," Proceedings of the 15th Annual general assembly of the International Association of Maritime Universities, pp. 36-45. 27-30 October 2014.
- [7] Capt. Allan Grey, "Master Mariners Congress 2015, 13-15 April 2015 Hand Book", Welcome from Convenor, pp. 3. April 2015.
- [8] <http://www.utas.edu.au/courses/set/units/kma003-mathematics-foundation-unit>