LEARNING THEORIES MEET VIRTUAL CLASSROOM TECHNOLOGIES: UNDERSTANDING NEW EDUCATIONAL OPPORTUNITIES IN MARITIME EDUCATION AND TRAINING

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Abstract. E-Learning is transforming Maritime Education and Training (MET) systems. United Nations Educational, Scientific, and Cultural Organization (UNESCO) states that E-Learning is key in the provision of technical vocational education and training (TVET). In maritime education and training (MET) systems, the potential of E-Learning is gradually being realized. However, there seems to be a lack of attention towards a linkage between the use of E-Learning and learning theories to understand what exactly facilitate good learning practices in MET. This paper discusses the values and applications of E-Learning in MET in terms of its relevance to learning theories. An explorative case study is reported where Multi-User Learning Environment (MUVE) technologies were devised for training seafarers. Using MUVE, two virtual classrooms were developed where students from three different MET institutions, namely the World Maritime University (Sweden), Ho Chi Minh University of Transport (Vietnam), and Myanmar Maritime University (Myanmar), participated in lectures. One virtual classroom offered a lecture concerning non-technical skills and the other on technical skills for seafarers. The research was funded by the International Association of Maritime Universities (IAMU) as the project No. 2013-4. Based on the analysis and discussion of the cases, this paper furthers a structured understanding of E-Learning applications in MET by establishing a linkage with learning theories. By using the outcome of the IAMU research project on MET virtual classrooms, the paper contextualises the specific

pedagogic approaches employed in the MET virtual classrooms and makes sense of the ICT-supported methods in MET. The paper concludes with suggestions to the IAMU member universities on the use of learning theories to the introduction of ICTs in MET.

Keywords: Information and Communication Technologies (ICTs) · Virtual classrooms · Maritime Education and Training (MET) · Learning theories

1. Introduction

A rapid development of technology and its application to education have brought a range of opportunities to Maritime Education and Training (MET). MET used to focus on mastering hard technologies, such as radar, ultrasound/sonar device, power generator, main engine, and so on. Though some modern technologies, including an electronic chart and Automatic Identification System (AIS), were added, the recent virtual, cloud-based, or robotic technologies are bringing a new phase of innovation in the maritime industry. The challenge for MET is such technologies can be adopted based on sound learning approaches to enhance the learning experiences of maritime students.

From an educator's viewpoint, this paper discusses the values and applications of E-Learning in MET with reference to learning theories. As one modern approach, Multi-User Learning Environment (MUVE) technologies are examined in connection with learning theories. Specific pedagogic approaches employed in the MET virtual classrooms from the IAMU research project are revisited to discuss the ICT-supported methods in MET for the benefit of IAMU member universities.

2. Modernization of MET

This section provides an overview of MET and the application of E-Learning in education, with a particular focus on MUVE technologies.

2.1. MET and E-Learning opportunities

MET is understood as part of technical vocational education and training (TVET). The United Nations Educational, Scientific, and Cultural Organization (UNESCO) promotes E-Learning as a key in the provision of TVET (UNESCO, 2012). UNESCO recognizes how ICT fundamentally impacts how we access information and how we communicate with each other

(UNESCO, 2015). ICT has a transformative impact on how we live our lives. In education, ICT developed for E-Learning and Learning Management Systems are transforming the educational landscape (*ibid*). New pedagogy and andragogy opportunities open up for delivering education in the classroom as well as through distancE-Learning. But, there are very little research about theoretical and pedagogical approaches to the use of ICT in MET.

The history of MET can go back to the Age of Sail when rather informal apprenticeship was based on on-the-job training on board ships. More formal and structured MET was developed by the adoption of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as Amended (STCW). At all time, the maritime industry has relied on competent seafarers to safely operate ships. It should be noted that seafarers are not only important to work at sea but also to use their operational knowledge in shore-based maritime jobs, such as maritime administrations, ports, educational institutions, shipping companies, and others.

MET is designed for providing specific education and training necessary to seafarers under STCW. STCW offers a comprehensive set of competence tables in which describe both managerial and operational levels of seafarers need to be trained. STCW sets out the minimum requirement of seafarers' competences and competence-based training is practised in classroom, simulators, and on-board training. There are emerging interests from both maritime administrations and industries to use online assessments for seafarers' licenses and additional certificates. More opportunities of E-Learning in MET are arriving in new model courses and train-the-trainer exercises.

Muirhead (2003) recognizes how global MET is currently subject to great change brought about by the growing impact of technology, which relates to an increasingly dynamic shipping environment and new international legislation. Muirhead's study concludes that maritime institutions can benefit from the use of new technology, but only through rational planning and sustainable staged growth.

2.2. MUVE technologies to transform MET

The empirical research of this paper targets a novel E-Learning technology referred to as MUVE. MUVE describes a persistent 3D graphical environment that can be accessed over the internet and allows users to simultaneously and in real-time interact and communicate with each other (Salt, Atkins, and Balckall, 2008). A user in MUVE are digitally represented through what is referred to as an avatar, which is 3D graphical character in MUVE that is

operated by the user through a user interface such as a keyboard and mouse. A number of reputable educational institutions, including Harvard, MIT, and Open University have designed educational activities in MUVE. MUVE enables educational activities to be designed that goes beyond and complements, for example, E-classrooms that use video technologies to create shared learning spaces through introducing the dimension of space.

It is evident that the modernisation of learning experience in MET is partly facilitated by E-Learning. This paper, however, sets out to move beyond a mere excitement by technology-based learning, such as E-Learning, where the attention to learning theories may become less important in MET curriculum development processes. For this purpose, this paper uses one advanced E-Learning case (i.e., MUVE) from a IAMU research project to understand how learning theories are relevant when introducing ICT in MET, and explores the applications of modern technology in MET.

3. Learning theories

Learning theories are developed to improve the understanding of how we learn in general and through structured educational activities arranged by educational institutions. In this paper, learning theories are used to improve the understanding of the application of E-Learning technologies.

Understanding how people learn has been one of the main philosophical debates since 500 BC when the Greek philosophers, such as Plato and Aristotle. While the discipline of Psychology also contributed to understand the mind of humans till the 19th century, behavioural and cognitive psychology advanced learning theories in the 20th century (Bates, 2016). According to Bloom's revised taxonomy, there are six levels of intellectual development: Remember (level 1); Understand (level 2); Apply (level 3); Analyse (level 4); Evaluate (level 5); and Create (level 6) (Anderson and Krathwohl, 2001). It is possible to assume that traditional learning practices often fall in lower levels of Bloom's taxonomy, and our research aims at transforming from the traditional MET practice of memorising information to more interactive, immersive learning with ICT.

In the use of MUVE, Pham (2012) investigated how "learning by doing" for competence-based training relates to the STCW competence tables as well as community-based learning. Pham's premise is that MUVE can be used to enable "learning by doing" through E-Learning technologies in MET. This is connected to Dewey's recognition that knowing and doing are tightly coupled (Dewey, 1916, 1958). Learning happens in the context

of an activity where a person is trying to accomplish some meaningful goals and has to overcome obstacles along the way. In addition, Pham connects the application of MUVE to practice-based social learning. This relates Wenger's (2001) notion of learning in communities of practices where learning happens through "a group of people who share an interest in a domain of human endeavor and engage in a process of collective learning that creates bonds between them".

Among many useful learning theories, this paper furthers the investigation of several relevant learning approaches to our research. A well-known pedagogical method established by Montessori is popular among the parents who have young children. In her theory, pupils' motivation is stimulated by movement which enhances thinking and learning. The teacher acts as a facilitator and creates a stimulating learning environment to develop the pupils' "absorbent mind" and make their learning experience more meaningful (Hainstock, 1997). Caine and Caine (1997) suggest a paradigm shift in teaching and assessment from memorising information to meaningful learning. A human brain accepts patterns that are relevant while it rejects patterns that are meaningless. Teachers therefore ensure that their lecture offers the right level of challenge and students are able to express their ideas in the learning process. This view is further emphasised in terms of creativity and the ICEDIP model[1] by Petty (1997). A learner's attitude also influences learning outcomes, hence a motivation for learning is essential (Curzon, 2006). In group exercises, Tuckman (1965) emphasises the importance of providing guidance to the team at the beginning of team formation. His group development model describes the five essential parts of the process: Forming (interaction); Storming (mingling and conflicting); Norming (problem-solving and cooperation); Performing (confidence and trust); and Adjourning (a sense of satisfaction or loss).

It is considered that the current teaching and learning practices are often based on such learning theories, which are embedded in curriculum design and delivery and designed to enhance learning outcomes. On the arrival of ICT, there is a growing interest in how people process information. A massive flow of accessible information and the availability of ICT tools in both public and private enable both teachers and students to transform the experience of education and training.

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[1] The ICEDIP model is an acronym of six elements: Inspiration, Clarification, Distillation, Incubation, Perspiration, Evaluation. See the detail in the book by Petty (1997).

4. Research methods

The paper aggregates qualitative research from two case studies that were part of a IAMU-funded research project, No. 2013-4. A common way to aggregate qualitative research is multiple case studies (Yin, 2013) or meta-ethnography (Britten et al., 2002). Multiple case studies are typically designed as such, and the cases are chosen to triangulate specific research questions. Meta-ethnography involves aggregating previously published research. This case is a hybrid between the two. In this paper, the purpose is to revisit the case studies of the IAMU research project to understand the values and applications of E-Learning in MET through the use of learning theories, which extends the analysis and discussion of the original research[2].

The 1st virtual classroom as a case study focused on non-technical skills of seafarers, including leadership, teamwork, cultural awareness. Dr. Kitada of the World Maritime University (WMU) taught the class with 6 students from WMU, Sweden; 2 from Ho Chi Minh University of Transport (HCMC-UT), Vietnam; and 3 from Myanmar Maritime University (MMU), Myanmar. The 2nd case study took place on a virtual ship, focusing on technical skills of seafarers, including nautical equipment and regulations. Dr. Kitada of WMU as a teacher and three cadet students from HCMC-UT participated in the 2nd virtual ship classroom.

For analysis, the interactions both inside and outside the virtual classroom and virtual ship in MUVE were recorded by video and audio. The following section re-interprets the original empirical research and its analysis in connection to the learning theories presented in section 3.
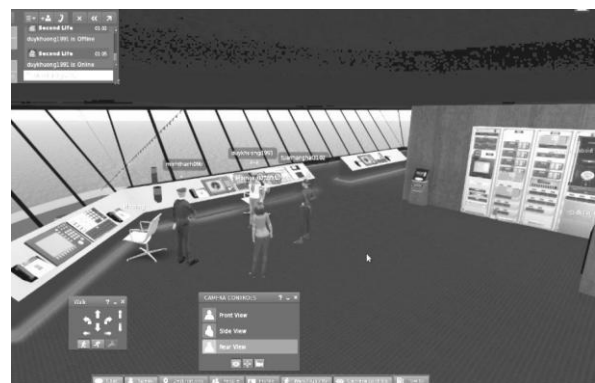
5. Empirical data analysis: Using MUVE in MET

The virtual MET classroom and ship presented a number of challenges and opportunities for

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[2] Find the details about the original IAMU research No. 2013-4 by Pham et al. (2014).

the application of MUVE in MET (see Pham et al., 2014). This paper focuses on the analysis of each unit of learning in relation to learning theories. Figure 1 shows the snapshots from the virtual MET classroom and ship. Table 1 and 2 make a breakdown of learning units in the respective case.

Figure 1: The teacher and students interacted by avatars in the 1st virtual classroom (Left) and the 2nd case on board a virtual ship(Right)

Table 1: The 1st virtual classroom focused on non-technical skills of seafarers

Learning objectives	Activities	Achieved learning outcomes	Core learning theories (authors)
To become aware of cultural diversity among students.	Ice-breaking. Walk around the virtual classroom and find a partner to introduce themselves.	Students engaged in talking to other students and became familiar to the diversity of classmates	The absorbent mind (Montessori)
To understand additional requirements made by the STCW Manila Amendments.	Lecture on STCW Manila Amendments	Students were able to describe what are additional requirements in the STCW Manila Amendments.	"Remember" and "Understand" in cognitive process dimension (Bloom)
To discuss and understand different needs of multinational seafarers. To understand the importance of leadership and teamwork in problem-solving.	Instruction of group work	Two groups were formed.	The group development model (Tuckman)
	Group work (A scenario was given to discuss how to use a welfare budget on board. The group worked in team and the role-play of a leader and followers was used.)	Students were able to discuss the different needs of multinational crew and reached a consensus of the wish list.	
To evaluate and appreciate the differences of crew and teamwork.	Wrap-up	Each group reported their discussion results and the teacher showed how it linked back to the knowledge about STCW.	"Evaluate" in cognitive process dimension (Bloom)

Table 2: The 2nd virtual ship focused on technical skills of seafarers

Learning objectives	Activities	Achieved learning outcomes	Core learning theories (authors)
To familiarise the self to the other peers and teacher.	Self-introduction.	Rapport was established.	The absorbent mind (Montessori)
To understand the different functions of nautical equipment on board.	Walk around the virtual bridge. Students need to answer the questions by the teacher.	Students were able to explain different functions of nautical equipment on virtual ship.	Meaningful learning (Caine and Caine)

To apply maritime regulations when using nautical equipment.	Students are asked which regulations relate to the operation of specific equipment.	Students were able to apply maritime regulations and explain the appropriate use of nautical equipment.	Motivation theory (Curzon); "Apply" in cognitive process dimension (Bloom)
To be creative to design a future virtual ship.	Immediate reflection and feedback.	Students were able to make suggestions and innovative ideas for their ideal virtual ship.	Creativity and the ICEDIP model (Petty); "Create" in cognitive process dimension (Bloom)

In both virtual MET settings, the learning objectives were successfully met and the relevant learning theories were applied when designing the activities of each learning unit. For example, in the 1st virtual classroom, the students' learning was enhanced by movement (i.e., walking around by avatars) as part of the Montessori technique; the lecture on the STCW Manila Amendment was categorised as the levels of "Remember" and "Understand" in Bloom's cognitive process dimension; the group work considered Tuckman's group development model for effective engagement among students; and the wrap-up offered the students to evaluate and appreciate leadership, teamwork, and cultural awareness in the group work, which are relevant to the "Evaluate" level in Bloom's cognitive process dimension. The 2nd virtual ship began again with the Montessori technique to focus on self-realisation in ice-breaking; students were excited to walk around the virtual ship and found the learning environment relevant and appropriate to themselves as cadets (i.e., Caine and Caine's meaningful learning); with motivation (Curzon's motivation theory), students applied regulations to the use of nautical equipment (i.e., the "Apply" level in Bloom's cognitive process dimension); and finally students were able to present their creative and innovative ideas for a future virtual ship, and Petty's creativity and the ICEDIP model and the Bloom's "Create" level in cognitive process dimension helped this unit of learning.

From the analysis of two virtual MET classrooms through learning theories, it is evident that each unit of learning can be enhanced by the application of learning theories. It was assumed that learning non-technical skills would require "creativity" which is recognised as the highest level of Bloom's revised taxonomy. Surprisingly, according to our analysis, the virtual classroom, focusing on technical skills (in this case, nautical equipment and regulations) appeared to find "creativity" and "evaluation" useful and relevant. It implies that there are a lot of potentials in MET to shift from the "Remember" level to the "Create" and "Evaluate" level in its curriculum design and delivery.

6. Discussion and Conclusion

In this paper, the previous IAMU research project was revisited in order to understand how learning theories can enhance learning experience of students in the virtual MET classrooms. An analysis on how learning units in MUVE are relevant to different learning theories revealed untapped potentials in MET. Even the course on technical skills can adopt the higher levels of Bloom's revised taxonomy, such as "Create" and "Evaluate". It indicates that MET can be transformed from "remembering" information to "creating" and "evaluating" knowledge in the maritime sector. The limitation of this study is the lack of consideration of various factors to influence the successful integration of ICT and learning theories in MET. It was observed, however, that students were motivated and interested in learning in the virtual MET classrooms. Further research will help to understand how effectively learning theories can be integrated in the use of ICT in MET.

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