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Impact of emerging technologies on maritime education and training: a phenomenological study

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IMPACT OF EMERGING TECHNOLOGIES ON MARITIME EDUCATION AND TRAINING:

A PHENOMENOLOGICAL STUDY

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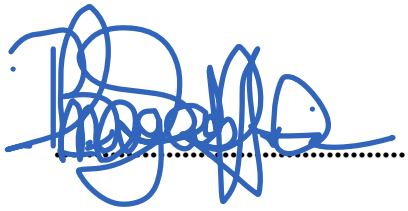
Declaration

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.

(Signature): 

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Abstract

Title of Dissertation: **Impact of Emerging Technologies on Maritime Education and Training: A Phenomenological Study**

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This phenomenological study aims to investigate the impact of emerging technologies on Maritime Education and Training (MET) and how these technologies affect MET programs, activities, and practices. Several previous studies have found a significant positive association between the perceived usefulness of technology and consumer attitude toward technology adoption. Hence, understanding how MET instructors and trainees perceive emerging technologies is essential for informing MET research, policy, and practice. This study utilizes the technology acceptance model (TAM) to examine the adoption and use of emerging technologies from a phenomenological perspective.

Using a three-series interview schedule, a purposive sampling technique was employed for data collection from seven participants comprising MET instructors and trainees. The collected data were later transcribed, coded, and analysed using thematic analysis to identify major themes.

The study revealed that MET instructors and trainees have a positive attitude towards emerging technology as it creates an engaging learning environment for knowledge creation, creates collaborative opportunities, and promotes active participation among trainees. Despite these positive attitudes, the findings highlighted poor internet access, concerns about over-reliance on technologies, and technical glitches as major challenges to technology integration, adoption, and adaptation in MET.

The study further elucidates improvements in MET practice and policy by leveraging emerging technology integration in its various perspectives, thus holding critical implications for policymakers, including investments in research and development and pilot projects to explore the optimal use of emerging technologies in MET.

The study has shown the potential of the phenomenological approach, which is instrumental for further longitudinal studies on technology adoption and adaptation trends necessary to fill existing knowledge gaps in the attitude, experience, and perception of emerging technologies in MET. Additionally, insights gleaned from these findings can support informed decision-making and evidence-based strategic planning to advance and sustain MET practices.

KEYWORDS: Emerging Technology, Phenomenological Study, Maritime Education and Training, Technology Acceptance Model

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List of Abbreviation

AI	Artificial Intelligence
AR	Augmented Reality
CHATGPT	Chat Generative Pre-Trained Transformer
DOI	Diffusion of Innovation
E-LEARNING	Electronic Learning
E T	Emerging Technology
IAMU	International Association of Maritime Universities
IMLA	International Maritime Lecturers Association
IMO	International Maritime Organisation
IoT	Internet of Things
LMS	Learning Management System
MET	Maritime Education and Training
METIs	Maritime Education and Training Institutions
ML	Machine Learning
MR	Mixed Reality
TAM	Technology Acceptance Model
TPCK	Technological Pedagogical Content Knowledge Theory
UAE	United Arab Emirates
UK	United Kingdom
UTAUT	United Theory of Acceptance and Use of Technology
VR	Virtual Reality

Chapter 1 – Introduction

Maritime Education and Training (MET) is one of the pillars of an effective, sustainable maritime industry. A highly trained, competent, and skilled workforce across business and operational domains is required for a successful and sustainable industry capable of responding effectively to the dynamic demands of global trade and the shipping industry (Sharma & Nazir, 2021). Global dynamics in the international marine domain have prompted rapid shifts in MET approaches and policies, including integrating innovative technologies into MET policies (Wahl, 2020; Bertram & Plowman, 2020). Effective MET is imperative for overcoming underlying workforce challenges to keep up with the rapid and dynamic changes in the industry. The recent COVID-19 pandemic, for instance, prompted the rapid, unplanned adaptation of highly novel organizational and technological solutions to several maritime domains, especially in the education and training of officers (Renganayagalu et al., 2022). Understanding current trends on emerging technologies in MET and dynamics influencing referent policies and programs is a research and policy imperative.

1.1 Background and Problem Statement

The global shipping industry contends with multidimensional and interrelated issues, from stricter golden standards and the rapid digital revolution to challenges related to an increasingly diverse workforce (Boguslawski et al., 2022). Qualified and competent staff are crucial enablers of industry performance and sustainability. There is a consensus in the extant literature about MET as a fundamental determinant of quality outcomes in the shipping industry (Erdogan & Demirel, 2017; Bertram & Plowman, 2020). Efforts and incentives to improve MET globally are based on several standards, including providing full support to MET, exceeding the minimum requirements to have competent human resources, establishing close cooperation between MET and the industry, and increasing the number of trained and qualified seafarers at the local and global fleet levels (Erdogan & Demirel, 2017). Critical challenges persist despite significant efforts and commitment to pursuing these goals (Jensen & Konradsen, 2018).

Emerging technologies, like digital technologies, artificial intelligence (AI), machine learning (ML), augmented reality (AR), the Internet of Things (IoT), e-learning, and Learning Management Systems (LMS) present both a challenge for MET and opportunities for improvement.

These technologies provide more opportunities to expand the potential for improving the training and educational experiences for both instructors and their learners (Jensen & Konradsen, 2018). While maritime industries embrace a robust regulatory framework to ensure workforce competency (Mallam et al., 2019), unforeseen operational demands and new technological trends continue to provide policy, operational, and administrative challenges (Renganayagalu et al., 2019; Sharma & Nazir, 2021). A burgeoning body of seminal and empirical literature has focused on critical trends in MET technologies (Sellberg & Lundin, 2018; Mallam et al., 2019; Bertram & Plowman, 2020; Jensen & Konradsen, 2018; Wahl, 2020). However, fewer studies have examined how these emerging technologies can be integrated into maritime education and training, and operations. Further research is required to explore the value of these technologies as a training enhancer in MET, focusing on outcomes like user motivation, level of immersion, and increased transfer of learning.

1.2 Purpose of the Study

The purpose of this phenomenological study utilizing the modified Van Kamm method proposed by Moustakas (1994) is to explore the perception, attitude and experience of instructors and trainees on the impact of emerging technologies on MET outcomes such as learning transfer, learner retention, and skill enrichment among learners. Exploring a phenomenon from the participant's point of view and first-hand experience improves the researcher's understanding of the phenomenon in question (Aspers & Corte, 2019). Understanding how MET instructors and learners perceive emerging technologies is essential for informing MET research, policy, and practice. Therefore, the researcher believes that findings from the proposed study may inform MET practice, and policy by leveraging first-hand experience and knowledge of emerging technologies in MET. Moreover, the study will add to the literature on MET, especially current MET trends.

1.3 Significance of the Study

Given the critical role of MET in the efficiency and sustainability of maritime organizations, further research is needed to provide insights into MET practice and inform policy processes. The phenomenological design was explicitly important and chosen to describe, through interviews, the perceptions and lived experiences of MET instructors and trainees (Bell, 2010), and reveals not only the "what" but also the "why" behind participants' attitudes toward technology (Laverty, 2003). This study may have far-reaching implications for several stakeholders in the maritime industry and academic communities. First, findings from this study may provide critical insights into the nuanced intersection of emerging technologies and MET. Even though existing literature has attempted to explore the nexus between technology and MET practice, the empirical focus on emerging technologies like AR, IoT, MR, ML, AI, LMS and e-learning is noticeably nascent.

The study contributes to phenomenological research by providing a novel lens through which the lived experiences and perceptions of individuals within a particular technological context is examined. The phenomenological study contributes to how technology impacts human experiences from the way trainees learn to the way instructors teach by studying participants' narratives and unveiling meanings that shape their attitudes and behaviors towards emerging technologies (Cilesiz, 2010). Understanding the lived experiences of individuals in the contexts of technology is important in designing technology that is user-centred and aligns with human needs.

Therefore, this study may fill this critical gap in the extant literature by contributing to the theoretical understanding of how these emerging technologies could be leveraged to enhance MET practices and policies. Second, this study may have practical implications for MET practice. For instance, these findings may demonstrate the practical applications of novel technologies in MET by highlighting how these technologies could be effectively integrated into current MET programs for optimal and sustainable outcomes. Such cognizance may aid the design and integration of more efficient training

modules and enabling technologies tailored to the specific demands of the contemporary maritime industry.

Third, this study may provide MET policymakers and stakeholders with relevant insight into the challenges, opportunities, and implications of these innovative technologies to facilitate the development of evidence-based policies that promote the adoption of novel innovations while ensuring MET quality and effectiveness. Lastly, findings from this study may contribute to improved operational efficiency, sustainability, and safety within the maritime industry and could foster data-driven innovations in MET by emboldening an informed integration of emerging technologies in MET practice.

1.4 Research Objectives

An enhanced understanding of the key technological trends impacting MET practice and outcomes is crucial for improving MET practice. The study explores three main objectives:

1. To explore the perceptions of MET instructors and trainees about emerging technologies and their influence on MET practice and outcomes.
2. To examine the attitudes of instructors and trainees towards emerging technologies influencing MET practice.
3. To understand the experiences of MET instructors and trainees with emerging technologies.

1.5 Research Questions

Toward achieving its objectives, the proposed phenomenological study seeks to answer the following research questions:

1. What are the perceptions of MET instructors and trainees about emerging technologies and their influence on MET practice and outcomes?
2. What are the attitudes of MET instructors and trainees toward emerging technologies influencing MET practice?

3. What are the experiences of MET instructors and trainees with emerging technologies in MET practice?

1.6 Limitations

Limitations are the identifiable constraints that may affect generalization in the study (Bell,2010). Several limitations of the research existed regarding the phenomenon being investigated. First, the subjective nature of the phenomenological research studies exclusively focuses on MET instructors and trainees. This may minimize crucial insights from other essential stakeholders like industry professionals and regulatory authorities whose unique and diverse perspectives could provide rich insight into the integration of technologies in MET practice. Hence, limiting the generalization of findings to a broader population. In addition, interview data limitations may contain vague responses due to network interference during the interview.

1.7 Delimitations

Delimitation helps define the study's context, boundaries, and scope (Creswell & Poth, 2018). Phenomenological research uncovers or opens participants subjective and complex experiences beyond quantitative data (Mihas 2019; Frechette et al., 2020). It explores emotions, perceptions, and narratives that alternative survey-based research approaches fail to fill. Firstly, the proposed study may be limited in scope for several reasons. For instance, the study's limited focus on essential technologies like AI, ML, AR, MR, VR, and IoT and may overshadow the potent impact of other key digital consumer technologies relevant to the broader exploration of trends and the impact of integrating technologies in MET. On the other hand, the study's exclusive focus on MET instructors and trainees, may overshadow crucial insights from other essential stakeholders like industry professionals and regulatory authorities whose unique and diverse perspectives could provide rich insight into the integration of technologies in MET practice.

1.8 Summary

This chapter provided an in-depth introduction to the research topic, outlined the rationale for conducting the research, and highlighted the significance of the study's findings on MET research and practice. This study is necessary as it aims to add to the limited literature on the impact of emerging technology on MET. The next Chapter will extensively review the existing literature on the nexus between emerging technologies and MET practice and outcomes.

Chapter 2 - Literature Review

The global shipping industry is inherently complex and contends with highly confounded, multidimensional, and interrelated issues, including stricter golden standards, rapid digital revolution within and beyond the industry, and challenges related to an increasingly diverse workforce (Boguslawski et al., 2022). These challenges make qualified and competent maritime staff a crucial enabler of the performance and sustainability of the maritime industry. The extant literature shows a consensus about the role of MET as a fundamental determinant of quality outcomes in the shipping industry (Erdogan & Demirel, 2017; Bertram & Plowman, 2020). Current efforts and incentives to improve MET globally have focused on providing full support to MET, enhancing the cooperation and coordination between MET and the industry, exceeding the minimum standards concerning competent human resources, and increasing the number of trained and qualified seafarers (Erdogan & Demirel, 2017). However, despite substantial commitments among policymakers and administrators and the positive progress with these remediation efforts, a myriad of critical challenges continues (Jensen & Konradsen, 2018).

As innovative consumer technology becomes more ubiquitous, the propensity and ability to adapt these revolutionary technologies within maritime education and professional training programs have become increasingly commonplace in the mainstream literature (Mallam et al., 2019). These technologies provide more opportunities to expand the potential for improving the training and educational experiences for learners and instructors alike (Jensen & Konradsen, 2018). The maritime industry embraces a robust regulatory framework to ensure the competency of the maritime workforce (Mallam et al., 2019). However, a gamut of unforeseen operational demands and new technological trends continue to suppress the progress of policy, operational, and administrative incentives (Renganayagalu et al., 2019; Sharma & Nazir, 2021).

The proposed study seeks to fill this gap by exploring the perceptions, attitudes, and experiences of MET instructors and trainees concerning emerging technologies in MET. This chapter reviews the current literature on emerging technologies and their adaptation and relevance to MET. This chapter begins with the literature review process, including the research process and methodology, followed by trends in studies on emerging technologies in MET, drivers of technology integration into MET, and challenges with technology integration in MET. This chapter concludes with a literature summary and directions for further research.

2.1 Literature Review Process

Literature reviews provide context for new research and help identify critical gaps in the current body of literature (Hempel, 2020; Snyder, 2019). A comprehensive literature review is crucial to understanding the role, effect, and challenges of emerging technologies in MET. Overall, there is a significant empirical focus on emerging technologies in MET (Mallam et al., 2019; Renganayagalu et al., 2022; Wahl, 2020). Existing research is predominantly focused on an overview of the technologies being used in MET and how policy approaches and interventions have sought to promote the adoption and adaptation of such technologies in MET practices and processes (Renganayagalu et al., 2022), including opportunities and facilitators of such emerging technologies, challenges, and gaps for policy intervention. This review also focuses on emerging themes in the extant literature concerning technologies in MET.

2.2 Search Methodology

An iterative process of searching and identifying relevant literature from various databases using search queries, critically appraising each source, and synthesizing the information obtained from each source was used. Many databases and search engines available in the university library, including Academic Search Complete, ProQuest, SAGE, Taylor and Francis Online, Education Source, ERIC, and Google Scholar, were used. Queries run on these databases comprised several key search terms, including “emerging technologies," "maritime education and training," "MET instructors," "MET

trainees," "perceptions," "attitudes," "experiences," "impact," "influence," and "practice outcomes." Moreover, terminologies related to specific emerging technologies relevant to the maritime industry were also used, including "virtual reality," "augmented reality," "simulation," "e-learning," "artificial intelligence," "autonomous systems," and "big data. A simple search query on ProQuest using the search string (“maritime education and training” OR MET) AND (emerging technologies)) yielded 160,557 results sorted by relevance. Further filtering the results by source type to include only scholarly journals yielded 5,479 results. Limiting the results by publication date to include only articles published within the past five years yielded 1,974 results. A search using ("maritime education and training") AND (literature review or systematic review) AND (technology OR Artificial intelligence OR virtual reality OR augmented reality OR e-learning) with the same filters yielded 78 results. The search results were limited to the MET context and peer-reviewed articles.

2.3 Trends in Studies on Emerging Technologies in MET

Several studies have explored trends and improvements in MET practices across the globe from a comprehensive overview. Key trends include innovations in the Fourth Industrial Revolution, environmental changes in the educational sector that warrant educational reforms, shifts in employment patterns and their effect on MET, individualized learning, and attributes of educational equipment and technology. There is substantial literature on each trend, and several key themes have emerged from the various strands of literature on integrating technologies into MET practice. This section summarizes the key trends in studies on emerging technologies in MET.

2.3.1 Intersection of Technology and Maritime Education

Emerging technologies VR, AI, AR, ML, IoT, LMS, and E-learning have gained popularity as effective tools for strengthening learning outcomes in various training environments and in MET contexts (Kim et al., 2023). Notably, the literature suggests that technology implementation in maritime education has been generally successful (Mallam et al., 2019; Sharma & Nazir, 2021; Kim et al., 2023). These technologies are

increasingly being used in teaching and learning to provide a safe environment for learning (Kim et al., 2023; Sharma & Nazir, 2021), enhance learning outcomes (Kim et al., 2023), enable self-paced learning (Tang et al., 2021; Renganayagalu et al., 2019), and enable data-driven decision-making and learning personalization (Pruyn, 2023; Munim et al., 2020). Integrating these technologies in MET offers innovative and efficient training modalities and practices that prepare seafarers for the challenges of the contemporary maritime industry.

2.3.2 Innovation and the Fourth Industrial Revolution

One strand of literature has focused on methods for contemplating the prominence and use of innovative equipment and ships in MET in the wake of the Fourth Industrial Revolution. Golam and Zakirul (2021) demonstrated that the fast-changing value of technology is also shaping maritime operations and equipment that require new professional skill sets and knowledge. For instance, Lee et al. (2019) studied the underlying characteristics of innovations, and the technology in modern autonomous ships. A similar study by Cicek et al. (2019) also analyzed the future technological requirements and trends in the global maritime industry from both educational and industrial points of view. Their findings support the arguments of Lee et al. (2019), emphasizing that MET practices can be significantly enhanced to embrace the future technological demands of the maritime industry.

2.3.3 Educational Laws, Methods, and Systems

Another strand has focused on new educational laws, methods, protocols, and systems relevant to the burgeoning industrial demand for environmentally friendly ships, autonomous ships, and changes in the maritime educational environment over time. These researchers have attempted to study maritime educational and training strategies to fill current research and practical gaps by developing highly adapted and effective MET curricula and techniques. Ochavillo (2020) and Bolmsten et al. (2021) explored the importance of developing a MET paradigm that assists individuals in identifying and embracing their unique competencies, values, and potentials. Ochavillo (2020) stressed

that the shift of MET from traditional face-to-face learning to alternative teaching and learning models like online learning, partly in response to the global COVID-19 pandemic and partly due to progressive innovations in the tech and maritime domains, factors like insufficient planning and preparation might suppress such progress. Therefore, Ochavillo (2020) proposed a catch-up program to facilitate the paradigm shift to the alternative learning delivery models.

Similarly, Bolmsten et al. (2021) emphasized that employment patterns in the maritime industry tend to shift with innovations and technological developments. However, despite their emphasis on a novel educational paradigm, neither of the studies presented specific optimal and foolproof MET techniques and approaches. Stakeholders involved in developing MET curricula have been compelled to decide the most appropriate and effective learning delivery method to enhance the competencies and abilities of seafarers in response to the rising industrial demand for eco-friendly and autonomous systems.

2.3.4 MET Educational Environments and Equipment

Lvova & Popova, (2019) examined the implementation of various technologies, including virtual reality technologies, mixed reality technologies (Campbell et al., 2022), and simulation technologies (Tan et al., 2020), in MET. Lvova and Popova (2019) confirmed that introducing simulator technologies and VR systems in MET enhanced MET efficiency, promoted the development of critical and professional thinking among learners, and augmented the quality of professional competency among learners. Comparatively, Tan et al. (2020) sought to overcome the challenges associated with traditional ship engine training for seafarers by developing a simulation-based headset, based on the HT Vive Pro hardware. Like Lvova and Popova (2019), their study also found positive impacts of simulator technologies on MET outcomes. A recent study by Campbell et al. (2022) investigated the impacts of using mixed space reality on MET outcomes. In mixed reality space, MET instructors and learners interact both physically and virtually from anywhere in the world (Kim et al., 2023). These above findings reveal that there is a need to link hybrid MET methods to traditional approaches with emerging technologies.

2.4 Drivers of Technology Integration into MET

2.4.1 User Attitude, Support, and Training

Many factors have been identified in the literature as causative drivers of integrating emerging technologies in MET. For instance researchers like Maphosa and Bhebhe (2019) have shown that the attitudes and perceptions of MET learners and instructors towards emerging technologies can sway their interest in and commitment to the technologies. In agreement with the findings of studies like that of Maphosa and Bhebhe (2019), Agustini et al. (2020) also emphasized the need for training in digital MET for both learners and instructors. Understanding the potential of these technologies to improve MET outcomes and enhance maritime safety can enhance the utilization of the technology.

Consequently, MET planners must be proactive in addressing potent scepticism and resistance to the adoption of innovative technologies in MET. The nature and quality of support and training MET instructors and trainees get regarding these emerging technologies can also significantly influence their perceptions, attitudes, and behaviors. Technological competence and digital literacy skills are paramount and can influence the decision to use technology (Agustini et al., 2020). For users of these technologies, technical support can be vital in troubleshooting issues, providing guidance, and ensuring a seamless implementation of the technologies in MET. While Maphosa and Bhebhe (2019) emphasized the need for trainees to join academic communities focused on digital systems, Agustini et al. (2020) highlighted the value of training in improving digital literacy. Both strands of the literature demonstrate the critical value of digital literacy as an accelerator of the utilization and adoption of emerging technologies in MET.

2.4.2 Innovation and Availability of Technology

Some authors have demonstrated a significant positive impact of the increased innovation, availability, and support of novel technologies like e-learning and LMS on the increased integration of technology into MET practices (Rosedi, 2022; Elmunsyah

et al., 2023). Shi and Fan (2021) Kunieda et al. (2021) noted that online learning technologies and blended learning have introduced viable opportunities for maritime education. However, the rate and efficiency of the application of these technologies in MET practices vary across countries and regions. For instance, Shi and Fan (2021) found that the utilization rate of digital technologies in MET in China was notably slow due to a lack of institutional support and mentorship. Like Shi and Fan (2021), Demirel (2020) corroborated the notion that technological improvements are rapidly transforming the shipping industry. Their study underscored various important changes in the conduct of maritime activities like education and training, including increased digitalization and high-level automation of key processes.

2.4.3 The Role of Maritime Institutions

Organizations like the International Maritime Organization (IMO) have fostered the development and implementation of key technologies like e-learning, LMS, AR, and ML in MET. The IMO provides the regulatory framework and authority to guide the application and implementation of MET policies, procedures, and technologies. One of the policy initiatives of the IMO has been to ensure greater transparency, communication, and visibility between the maritime industry and the public. Erdogan and Demirel (2017) demonstrate that International MET platforms like the International Association of Maritime Universities (IAMU) and International Maritime Lecturers Association (IMLA) have played a fundamental role in promoting the development and uptake of technologies in MET. However, Demirel (2020) found that the role of the maritime industry in MET is inherently limited and only spans some of the responsibilities in seafarer training. Thus, they note that addressing the challenges associated with the rapid increase in the number of cadets and the need for refined competencies for the digital era requires increased involvement of shipping companies in MET planning, management, and administration.

2.4.4 Appropriate Infrastructure

In addition, Najdet et al. (2018), Windiarti et al. (2019), and Krishnapatria (2020) emphasize the need for appropriate infrastructure and resources to support the adaptation of emerging technologies in MET. In addition to reliable internet access (Krishnapatria, 2020), appropriately designed and optimized hardware and software resources, including simulators, virtual reality equipment, and computers, are necessary to support technology use. Similarly, Boulougouris et al. (2019) accentuate the essential role of institutional support in promoting the utilization of MET technologies. Organizational policies and procedures that incentivize the adoption of technologies and provide sufficient resources are critical. Moreover, Demirel (2020) noted that enhanced collaboration between industry stakeholders, MET institutions, and suppliers of the technology is necessary to support the sharing of resources and best practices regarding the implementation of emerging technologies in MET practice.

2.4.5 The Global Pandemic

COVID-19 emerged as a leading driver of increased adoption of emerging technologies like AR, AI, ML, VR, and e-learning in MET. There is a consensus that the pandemic had a substantial impact on the industry, as evidenced by the accelerated adoption of emerging technologies in MET (Frei-Landau et al., 2022; Ochavillo, 2020; Rosli et al., 2022; Wee & Fehr, 2021). Restrictions during the COVID-19 pandemic accelerated the shift to remote learning facilitated by emerging technologies like virtual classrooms, teleconferencing, and e-learning platforms. These studies show that the pandemic catalysed the transition toward virtualization technologies across industries, including MET, to ensure the continuity of training and learning. As Alop (2019) and Bertram and Plowman (2020) assert, simulators and e-learning lead the new front in emerging technologies in MET, owing to their vast potential and benefits to promote MET outcomes.

The increased popularity and accessibility of alternative learning modalities like e-learning or e-training significantly enhanced the flexibility and accessibility of MET.

Many researchers have emphasized the potential of e-learning technologies in MET by noting that such technologies can provide trainees unprecedented and convenient access to materials, enabling their participation in virtual classrooms despite geographical limitations (Alop, 2019). Golam and Zakirul (2021) and Hjelmervik et al. (2018) demonstrated that emerging technologies like virtualization and simulator technologies provide convenience and flexibility, improving the ability of learners to personalize their learning schedules and behaviors to their distinct circumstances and needs. A distinct repercussion of the pandemic is that it led to the rapid development and advancement of collaboration and communication tools, such as virtual collaboration and document-sharing tools.

2.5 Benefits of Technology Integration into MET

Many studies have explored the benefits of emerging technologies in MET program outcomes and efficiency. (Dewan et al., 2023; Fracaro et al., 2022; Jensen & Konradsen, 2018). Kim et al. (2023), Mallam et al. (2019), and Pipchenko and Kovtunenko (2020) agree that simulator components like the 3D view can bridge the gap between real-life demonstration and virtual simulation, enhancing learning outcomes for trainees. Moreover, advanced simulator-based training has been found to improve learning outcomes, instructional efficiency, and effectiveness of movements, while reducing errors made by trainees during actual job performances. However, other researchers like de Oliveira et al. (2022) and Hontvedt and Øvergård (2020) emphasize the role of fidelity in enhancing learning outcomes. Consequently, this approach to MET training results in more favourable outcomes for learners compared to classical classroom-based learning. Hjelmervik et al. (2018) asserted that these technologies make learning possible even in cases of highly disruptive events like the global COVID-19 pandemic. Amidst an increase in the adoption of emerging technologies in MET since COVID-19, MET institutions that embrace these technologies in their maritime training programs seem to be doing well in terms of lower student attrition and dropout rates (Dewan et al., 2023). A study by Shen et al. (2019) on the DMSVLCC3D simulation assessment results demonstrates a promising and beneficial effect of simulator technologies on the

development of the professional skills of trainees. Moreover, the study findings indicated that the technology was highly valuable and engaging for most of the participants.

Lastly, Chae et al. (2021) demonstrated that using a combination of technologies like virtual reality can improve accessibility of MET content, reduce content delivery times, and enable safe delivery of training even in potentially hazardous situations. Yushan et al. (2021) found that novel simulator technologies provide trainees with essential skills for stress coping and incident management. Nonetheless, Raicu et al. (2020) cautioned that all users and beneficiaries of emerging technologies in MET must be vigilant about the potential challenges and complications associated with integrating emerging technologies into MET practices.

2.6 Challenges of Technology Integration in MET

Despite their great potential to promote learning and improve MET outcomes, integrating emerging technologies in MET is not without limitations or challenges. In addition to technical barriers, loss of physical touch between students and instructors, and difficulty in managing students, the heavy reliance of MET on technologies may present a potentially confounded challenge (Arslan & Ozkan, 2023). For instance, digital literacy can be a leading impediment for MET learners trying to use digital technologies and acquire course content (Alexander, 2010). The requirement of high technical assistance to use digital technologies may aggravate the cost barriers to adopting these technologies. Moreover, Wicks et al. (2015) demonstrated that cooperative learning, which is one of the tenets of digital learning in MET, can be problematic, especially in blended learning environments, because of challenges with supervising learners and learning processes in a virtual context.

Bolmsten et al. (2021) highlighted the lack of resources as a major challenge for the integration of technology into MET. They argue that most MET instructors and trainees lack appropriate technical resources, which tends to hamper the propagation of learning content and concepts and their integration into practice. Others like de Montreuil

Carmona and Irgang Dos Santos (2020) showed that insufficient knowledge of modern technologies among MET instructors can significantly suppress the implementation of digital technologies in maritime education. They argue that technological illiteracy and unawareness among instructors can create a situation where MET institutions are involved in unrelenting discussions about ways to improve student outcomes. Previous studies like Wach et al. (2011) and Tshabala et al. (2014) argued that insufficient knowledge about modern technology and its impact on MET outcomes can undermine students' ability and interest in using MET technologies.

Some researchers have demonstrated that these alternative technologies can subjugate the ability of instructors to organize and deliver learning content independently. Leshchenko and Bezlutska (2021) discussed the lack of the opportunity for instructors to autonomously organize content and processes without technical support or system administrators as the weak side of emerging technologies. Such a lack of independence can undermine the efficiency and effectiveness of MET. Comparatively, Arslan and Ozkan (2023) sought to explore the perceptions and attitudes of maritime students in Türkiye concerning the learning process and technical aspects of distance or online maritime education during the COVID-19 pandemic. The results of the study showed negative evaluations and attitudes towards distance education among maritime students in Türkiye. Together, these studies show that emerging technologies might not be favorable among MET learners and instructors alike. Nonetheless, according to Bartuseviciene and Valioniene (2021), MET institutions must be ready to leverage effective solutions for optimally educating highly adaptable maritime specialists. These solutions must be flexible to meet the volatile needs of the labour market as well as digitalization challenges.

2.7 Emerging Themes

Several themes emerge from the literature. Findings from previous studies highlight critical aspects of the nexus between emerging technologies and MET, including the intersection of emerging technologies and maritime education, adapting learning technologies, and the growing prominence of individualized learning in MET practice

globally. These strands of literature provide crucial information on the role emerging technologies play in contemporary maritime education and training.

2.7.1 Intersection of Emerging Technology and MET

There is a consensus that alternative MET modalities, especially those involving emerging technologies, are becoming more popular among MET institutions and contexts (Johnson & Evette, 2020). Consequently, the maritime curriculum will continue to evolve in response to changing market requirements. Additionally, autonomous maritime vessels are becoming more ubiquitous. Training competent seafarers capable of operating such sophisticated vessels will become a policy and research imperative for MET practitioners. However, there are no sufficient training frameworks to support the preparation and training of competent seafarers capable of meeting the evolving needs of the market. According to Emad et al. (2022), the exact equipment needed to train this novel breed of seafarers is currently not known. Demirel (2020) noted that part of the challenge in efficiently training seafarers precipitates from the limited involvement of the maritime industry in the MET process. Therefore, shipping companies should be more involved in the MET process as critical stakeholders, from the design of the learning materials to the administration of seafarer training courses.

Disruptive technologies in the maritime industry, especially in MET, will continue to cause rapid and continuous changes in MET practice. These technologies will continue to transform business methods and models while also creating opportunities for seafarers to develop new competencies relevant to the digital era (Demirel, 2020). The characteristics of the digitalization of MET include the availability of large tracts of data, data mining, AI, high-level automation, and efficient data sharing. Thus, there is a consensus that a new breed of highly competent seafarers will become crucial to the industry, with the most important attributes being leadership, ability to process large amounts of data, unwavering focus on critical issues, teamwork, understanding automation and its challenges, change management, continuous learning, stress management, and effective communication (Mallam et al., 2019; Demirel, 2020).

2.7.2 Adaptive Learning Technologies

The implementation of adaptive learning technologies is another key theme from the literature. Adaptive learning technologies are grounded as a pivotal tool for building the professional culture of future seafarers through MET. Voloshynov et al. (2021) highlighted that the implementation of high-fidelity adaptive learning technology has been possible through problem-solving based on real-life examples, adaptive introduction of MET content into courses, system trainer support, adaptive course navigation, and constant support environments for individual task execution. It is evident that these technologies are fundamental in building a highly capable professional culture for future seafarers capable of meeting the evolving needs of the market and industry. In essence, adaptive learning systems for future seafarers presuppose a more individualized learning path, timely provision of advice and objective control, enhancement of learning processes through greater autonomy, promotion of the development of research skills and competencies among learners, and improved cooperation and partnership.

2.7.3 Individualized Learning

Individualized learning has emerged as a major theme in the reviewed literature. The global shifts in the nature of work have created more incentives for individualized care, resources, and attention for employees. For instance, there is a greater desire for the availability and provisioning of one-on-one experiences for employees, including mentoring and coaching (Wee & Fehr, 2021). Mentoring and coaching provide individualized learning experiences for seafarers. Despite the benefits of the classical one-on-one training methods, these individualized learning experiences can be costly (Athanasopoulou & Dopson, 2018). There is a consensus that virtualized learning platforms have facilitated individualized learning modalities across industries, including maritime (Sanchez et al., 2023; Sanchez, 2022). The progressive shift from classical instructor-based learning to innovative, interaction-based learning has created an imperative for maritime practitioners and researchers to rethink how the diverse training methods in MET support student learning.

Interaction-based learning adopts a social constructivist viewpoint and emphasizes the value of the social context and learning environment in helping learners acquire a unique set of skills, knowledge, and abilities from the learning activity (Sanchez et al., 2023). With an increased shift towards personalized learning experiences, simulation technology is pivotal to efforts to provide personalized learning experiences at scale, even for geographically dispersed teams. Evidence from the literature demonstrates that the customization and automation of learning technologies, like simulators, AR, ML, MR and VR, can include the collection of objective metrics on personalized learning outcomes and feedback mechanisms tailored to the unique needs and circumstances of each learner. Sanchez (2022) argued that despite the increased popularity, accessibility, efficiency, and benefits of individualized learning technologies, a primary drawback of such technologies includes the upfront costs and the expertise required during design and programming.

Overall, the literature suggests that increased institutional support through the involvement of organizations like the IMO and shipping companies in the MET process could provide incentives for increased integration of technology into MET while also improving MET outcomes. Collaboration is crucial in creating optimal incentives, organizational cultures, policies, and frameworks for developing and utilizing cutting-edge technologies in MET. Linking MET institutions to other stakeholders in the maritime industry can improve knowledge sharing, accessibility of resources, and economies of scale. Other benefits include enhanced networking, globalization, collaboration, partnerships, and modernization of MET programs.

2.8 Gaps in the Literature

The literature review revealed several noticeable gaps in the extant literature. One, there was a distinctive dearth of comprehensive research studies that specifically examined the perceptions, attitudes, and experiences of MET instructors and trainees regarding the integration of emerging technologies in MET. While a few individual studies have examined these aspects, a holistic understanding of the stakeholders' perspectives is required to inform MET policies, strategies, and practices. Moreover, most of the

existing research focuses on a few emerging technologies, such as virtual reality or simulators, with noticeably limited exploration of the integration and use of other technologies like AI, ML, MR, AR, LMS, big data analytics, or autonomous systems. Further investigations that encompass the broad spectrum of emerging technologies are necessary to foster a robust understanding of the potential impact of these emerging technologies on MET.

Two, the learning outcomes and performance improvements associated with the integration of emerging technologies in MET have received limited attention in mainstream research. Even though studies highlight the perceived benefits and positive experiences of MET trainees associated with the utilization of emerging technologies, there is a further need for empirical evidence that accentuates or demonstra

tes their effectiveness in enhancing knowledge acquisition, skills development, and overall performance of MET trainees.

Three, the existing research predominantly focuses on the implementation of technologies within the unique circumstances and learning environments of MET instructors and trainees, disregarding the distinct yet highly insight-rich viewpoints, experiences, and perceptions of critical stakeholders like industry professionals, regulatory bodies, and employers. The highly collaborative and multidisciplinary nature of the maritime industry makes the inclusion of these stakeholders' diverse insights into research on the MET-technology nexus an imperative for gaining an all-inclusive understanding of the dynamics, challenges, opportunities, and expectations associated with the integration of emerging technologies in MET practice. This broader perspective emboldens the development of comprehensive MET frameworks tailored to the industry's needs to foster better alignment of MET practices with emerging technological advancements.

Lastly, fewer studies have explored the ethical considerations associated with the integration of emerging technologies into MET practice. The increasing proliferation and presence of emerging technologies make questions and concerns about data privacy,

cybersecurity, and the ethical ramifications of utilizing technologies in maritime training scenarios a research and practice imperative. Essentially, exploring these ethical implications is necessary to inform the development of MET guidelines or best practices that ensure the responsible use of emerging technologies in MET in line with the industry's ethical and security standards.

2.9 Summary

This chapter reviewed the literature on emerging technologies in MET practices. It also reviewed several trends in studies on emerging technologies in MET and drivers of technology integration into MET. Several themes emerged from the literature concerning the drivers and challenges of technology integration into MET practices and the benefits and potential challenges inherent in adapting technologies like AI, AR, LMS, ML, MR, VR simulators, and e-learning. The findings from this review reveal gaps in the evidence and provide a foundation for further exploration and understanding of the dynamics associated with implementing emerging technologies in MET. The next chapter outlines the research methodology that will be utilized to answer the research questions.

Chapter 3 - Methodology

3.1 Introduction

Technology has been shown to improve teaching and learning outcomes, including student engagement, lesson planning, and the personalization of learning (Carstens et al., 2021). The proposed study aims to understand the use of emerging technologies in MET as perceived and experienced by MET instructors and trainees using a phenomenological study to facilitate a comprehensive understanding of participants' diverse intents, experiences, understanding, and attitudes toward the problem under investigation (Creswell & Poth, 2018). Relatively, this study is guided by the technology acceptance model (TAM).

3.2 Research Design

This study investigates MET trainees' and learners' diverse perspectives, viewpoints, and experiences concerning emerging technologies in MET by using a phenomenological approach to qualitative research. The study utilizes qualitative research for several reasons. For instance, it is flexible and facilitates a comprehensive understanding of participants' diverse intents, experiences, understanding, and attitudes toward the problem under investigation (Creswell & Poth, 2018). Qualitative research might also be valuable in filling theoretical and empirical gaps that alternative survey-based research approaches fail to fill. The study lends itself to the interpretive paradigm that construes reality as multi-layered and composite, implying that the phenomenon under investigation – the nexus between emerging technologies and MET – can have several diverse interpretations among participants. The interpretive paradigm is based on epistemological assumptions (Creswell & Poth, 2018); that these experiences, attitudes, and perceptions of emerging technology in MET can only be understood and captured through the personal accounts of MET instructors and trainees. In addition, interpretive research relies on naturalistic inquiry (Lincoln & Guba, 1985; Angen, 2000, Clandinin & Connelly, 2004) like interviews, allowing the researcher to generate inferences and meanings from the research process. Therefore, this paradigm supports

using semi-structured in-depth interviews to gain access to participants' subjective comprehension (Seidman, 2006) and to collect complex and insight-rich data on the interlace between emerging technologies and MET. Furthermore, the interpretive context of the study was social constructivism as participants' points of view were subjective with their own interpretation of events, and the goal was to generate a theme within these interpretations (Creswell & Poth, 2018). Qualitative, semi-structured interviews allow phenomenological researchers to effectively understand the phenomenon from the participant's recollection, experiences, and perceptions (Lauterbach, 2018) and undoubtedly hold a significant position as a qualitative research methodology (Miles & Gilbert, 2005). Therefore, this paradigm supports using semi-structured interviews to collect complex and insight-rich data on the interlace between emerging technologies and MET.

3.3 A Phenomenological Approach

Phenomenology is a research approach focusing on participants' lived experiences (Neubauer et al., 2019). The phenomenological approach is appropriate for the proposed study because it focuses on the lived experiences, attitudes, and perceptions of study participants and how they make sense of those experiences (Moustakas, 1994). As posited by Creswell, in-depth phenomenological interviewing aims to explore a central phenomenon. I chose a phenomenological approach because the study aims to describe how participants experience a phenomenon to a "description of the universal essence" (Creswell & Poth, 2018). However, an individual's perceptions and experiences shape attitudes. Hassenzahl & Tractinsky (2006) stress that experience in technology goes beyond technology's practical needs, and it is complex, resulting from the interaction between the user's subjective state. According to Oskamp and Schultz (2005), attitudes can be influenced by one's perceptions of the behavior of perceived ease of use and perceived usefulness. Therefore, the phenomenological study was driven by three research questions.

1. What are the perceptions of MET instructors and trainees about emerging technologies and their influence on MET practice and outcomes?

2. What are the attitudes of MET instructors and trainees toward emerging technologies influencing MET practice?
3. What are the experiences of MET instructors and trainees with emerging technologies in MET practice?

3.4 Study Model (Technology Acceptance Model (TAM)

Technology can be defined as an entity that is intentionally devised, serving specific purposes from a secular perspective, and valued by intelligent beings (Carroll, 2017). The above definition aptly encapsulates my perspective of technology use in the context of MET practice. According to Daffin (2010), technology use is seen as "using technology to solve real-world problems. Technology use in maritime education and training institutions (METIs) has been lauded for its ability to create a dynamic learning setting that engages students, gives instant feedback, facilitates collaborative learning. (Firmin & Genesi, 2013) and assists students with the construction of knowledge.

Several theories and models have been used to study the adoption and role of technology in education. This includes the Technology Acceptance Model [TAM; Mtani & Mbelwa, 2022; Zhang et al., 2020], Unified Theory of Acceptance and Use of Technology [UTAUT; Masmali & Alghamdi, 2021], Social Cognitive Theory (Almugrin & Mutambik, 2021), and the Technological Pedagogical Content Knowledge theory [TPCK; Aslam et al., 2021].

The TAM (Davis, 1989; Davis et al., 1989) was developed to predict and understand the adoption and utilization of technology. The technology acceptance model (TAM) is selected as a guide in the research study to examine the attitude of MET instructors and trainees which is influenced by perceived usefulness and perceived ease of use in the context of technology application (Chen et al., 2018). In the maritime education context, perceived usefulness connotes the extent to which an individual believes that adopting or using a technology can improve their job performance (Davis, 1989). Several studies exploring the effect of user attitude on technology adoption have found a significant

positive association between the perceived usefulness of technology and consumer attitude (Sahi & Gupta, 2013; Manis & Choi, 2019), especially in MET practices.

TAM is a well-recognized, validated, and widely used model in phenomenological study (Hurston, 2007; Sandiford, 2013; Grey, 2019; Ozkale & Koc, 2020; Daffin, 2022) to investigate the use of new or existing technologies in various learning contexts. The technology acceptance model (Davis, 1989) asserts that users are more likely to use technology if they feel it is useful. Therefore, the model is essential for perpetuating research and scholarly efforts on emerging technologies.

3.5 Population and Participant Selection

The data for this study was collected from seven participants involving a relatively homogenous population to effectively address the research question under investigation (Padgett, 2016). Qualitative research neither adheres to a predetermined formula nor mandates a specific sample size a priori as long as it focuses on the richness and quality of the study rather than quantity (Busetto et al., 2020; Sim et al., 2018). Creswell & Poth (2018) denoted that sample sizes for usually considered appropriate phenomenological research design ranges from 3–10 participants.

Participants were selected from diverse geographical locations to have a mixed representation from developed, emerging, and developing countries such as Asia (Specifically the Philippines), Europe (precisely the UK), the Middle East (the UAE), and Africa (Nigeria) to provide valuable insights on how these emerging technologies affect maritime education and training from their global expertise.

Study participants were selected based on their capacity and capability to provide richly textured and appropriate insight into the interlace between emerging technologies and MET. This sampling approach allows for choosing information-rich cases to answer the research questions. Participants were recruited using purposive sampling based on the predetermined criteria to achieve the study objectives (Seidman, 2006; Creswell & Poth, 2018), while representing all possible variations expected to be valuable based on

previous experience, mainstream literature, or underlying theory (Busetto et al., 2020). This method was appropriate for this study because the study required participants with experience teaching or learning MET and proficiency in English.

3.6 Data Collection

The primary instrument for data collection well-suited to studies of experience is in-depth phenomenological interviewing. In-depth phenomenological interviews are qualitative, semi-structured interviews that allow participants to narrate their lived experiences in their own words (Bevan, 2014) and perceptions of the interlace between emerging technologies and MET (Creswell & Poth, 2018).

The study was conducted using a three-series interview schedule lasting for 60 - 90 minutes as posited by (Cilesiz, 2010) which enables rapport building and information gathering with each participant. This approach enhances dependability, strengthens the reliability of the information obtained (Padgett, 2016), and benefits both the researcher and the participants (Seidman 2006).

Further probing and follow-up questions were employed to clarify participants' responses and to garner further details where necessary. The schedule also includes questions on demographic information regarding role, years of experience, positions, gender, and specialization to describe the study participants as a group.

3.7 Procedures

Recruitment was done by emailing MET i.nstructors and requesting them to participate in the study. Potential participants were informed about the study's purpose, procedures, ethical issues and safeguards, and their rights as participants. Interested participants were given a consent form to review before the interview. To guarantee the attainment of significant knowledge regarding emerging technologies in the domain of MET, the investigation exclusively considers individuals who meet the subsequent requirements of a minimum of one year of experience in either teaching or learning with MET. In addition to the one-year experience with MET, the inclusion criteria included direct involvement in MET programs as instructors or trainees and willingness to share

experiences with technologies in MET. Participants of all races, ethnic backgrounds, and genders were qualified for inclusion. The criteria for participant selection were carefully developed to identify the most suitable individuals for our research study effectively.

Interested participants indicated their interest in participating in the study interview. Thereafter the interviews were conducted virtually via Zoom based on the participant's preferred date and time. Before the interviews, the researcher explained the purpose of the study interview and informed participants about the ethical standards observed. Moreover, with participants' permission, the interview was recorded to ensure accurate capturing of their responses and subsequently prepared for transcription and analysis. The researcher took detailed notes and documented key points, notable quotes, and observations to assist in data analysis to maintain the integrity of the findings and steer clear of any form of prejudice.

3.8 Data Analysis

In the data analysis process, I observed all approaches to ensure there are no prejudged biases 'deliberate naïveté'' (Cilesiz 2010). All interviews were recorded with permission of the interviewee to facilitate their transcriptions for a rigorous subsequent data analysis. This approach involves the researcher's constant, simultaneous, and active engagement in analysing, abstracting, and comparing the obtained data (Aspers & Corte, 2019).

Interview transcriptions were imported to Nvivo 14 for thematic analysis. I assigned codes that were grouped into categories and sub-themes to facilitate the identification of key themes that emerged from the participants' narratives. The themes were complemented with researcher notes taken during the interviews and memos and annotations made during the coding process. Each theme was briefly defined using direct quotations from the transcripts. This comprehensive process ensured a thorough exploration of participants' perceptions, attitudes, and experiences with emerging

technologies in MET, providing valuable insights into the integration and impact of these technologies.

3.9 Ethical Considerations

The two main ethical issues in qualitative research are confidentiality and the role of the researcher (Creswell & Poth, 2018). To maintain the integrity of the research, ethical standards were strictly observed. Prior to the actual data collection, participants were sent a consent form and information on the rationale of the study. The interview was conducted voluntarily, and participants were allowed to withdraw participation at any time. Lastly, the use of pseudonyms was employed to protect the participant's identity.

3.10 Summary

This chapter presented participants' selection as well as the methods used for data collection and analysis. Moreover, the chapter suggests that TAM is commonly utilized in phenomenological research and has been leveraged and adapted to study various factors affecting the users' propensity and desire to utilize technology. Findings from this study may provide credible evidence for progressing the TAM model as a wholesome model for studying the technologies used in MET. To collect the data, I utilized interviews with the participants. For data analysis I used a coding method of the statements that were analysed and reduced to key themes. Finally, the participants' private information and personal data were protected with the highest possible security. The next chapter will be findings of the study from the data collected.

Chapter 4 - Findings

4.1 Introduction

The purpose of the phenomenological study was to examine MET instructors' and trainees' diverse perspectives, attitudes, and experiences concerning emerging technologies in MET and how these technologies affect MET programs, activities, and practice. The chapter presents the findings from the data gathered. The chapter is organized in themes derived from the three research questions in chapter 1. The result of the thematic analysis is integrated with the information gathered from the interviews.

4.2 Participants Summary

The participants for this study included seven MET instructors and trainees with diverse roles within MET institutions. Participants were 4 instructors from India, the Philippines, Nigeria, and the United Arab Emirates, and 3 students from the UK, and the Philippines. These participants represented a range of roles, locations, genders, years of experience, positions, and specializations. Notable participant demographics included:

Participant 1 was one of the first Indian female Captain. She has acquired experience in oil tankers, containers and bulk carriers and passenger. She is currently working as a nautical faculty/training superintendent with 20 years of extensive experience in maritime operations and training.

Participant 2 is a Curriculum Developer and Instructor with 7 years of experience, specializing in port operation and administration. He has an in-depth knowledge on the Learning Management System.

Participant 3: He is an Assistant Professor. His interaction with maritime education and training started after his Master of Science degree at Malmo in the World Maritime University 20 years ago. Before then, he was an instructor in maritime education on the

vocational level for second mates, and chief mates in Egypt. He has 23 years of experience in maritime education and training.

Participant 4 is a Lecturer involved in seafarer training since 2016. He holds a Master of Science degree at the World Maritime University.

Participant 5 is a Marine Engineering student with 10 years student experience. Participant 6 is a Marine Engineering student with 4 years student experience.

Participant 7 is a marine transportation student with 4 years student experience. Specific demographic data for each participant are shown in Table 1.

Table 1: Participants Background Information

Participant Number	Role	Location	Gender	Years of Exp.	Position	Specialization
1	Instructor	India	Female	20	Master	Nautical Faculty/Training Superintendent
2	Instructor	Philippines	Male	7	Curriculum Developer and Instructor	Port Operations & Administration
3	Instructor	United Arab Emirates	Male	23	Assistant Professor	Maritime Studies, Technology & Science
4	Instructor	Nigeria	Male	7	Lecturer	Seafaring Training
5	Trainee	United Kingdom	Female	10	Student	Marine Engineering
6	Trainee	Philippines	Male	4	Student	Marine Engineering
7	Trainee	Philippines	Male	4	Student	Marine Transportation

Sourced (Author, 2023)

Participants had three distinct roles. As seen in Figure 1, the study shows that 4 of the participants are instructors who provide MET in diverse maritime disciplines or specialized areas with experience in integrating emerging technologies into their teaching practices. Three are trainees who are cadets, officers currently enrolled in MET courses, or maritime professionals who are seeking further advanced training with firsthand experience in learning through the utilization of emerging technologies. Lastly, it was observed that 3 out of the 4 participants held dual instructor-trainee roles.

This implies that they experienced the shift from trainees to becoming instructors. Their past and present roles have provided a comprehensive understanding of the impact of emerging technologies within MET.

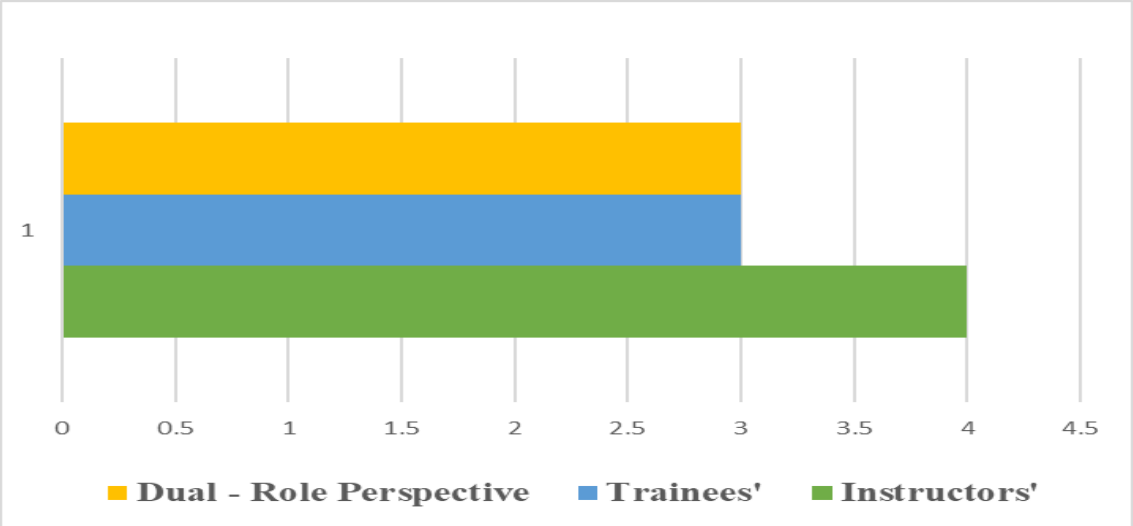

Figure 1:Overview of Participant Distinct Roles

Sourced (Author, 2023)

Participants also varied by sex or gender. Participant gender ratio of females to males is 2:5 and exhibited varied experiences with emerging technologies in the MET context.

4.3 Findings

Phenomenological data analysis is the process of transcending the mundane nature of each description to reveal the essence of the phenomenon. Drawing from the in-depth semi-structured interviews with a diverse cohort of participants, this section presents the findings from the data analysis to foster a nuanced understanding of the integration and impact of emerging technologies within the MET landscape. The themes and sub-themes that emerged from the qualitative data analysis shed light on the multifaceted nature of participants' perspectives and provide valuable insights into the complex dynamics surrounding the adoption and utilization of technology in MET. Findings from the data analysis have been organized by themes, with each theme referencing several sub themes and codes from the analysis (See Figure 2).

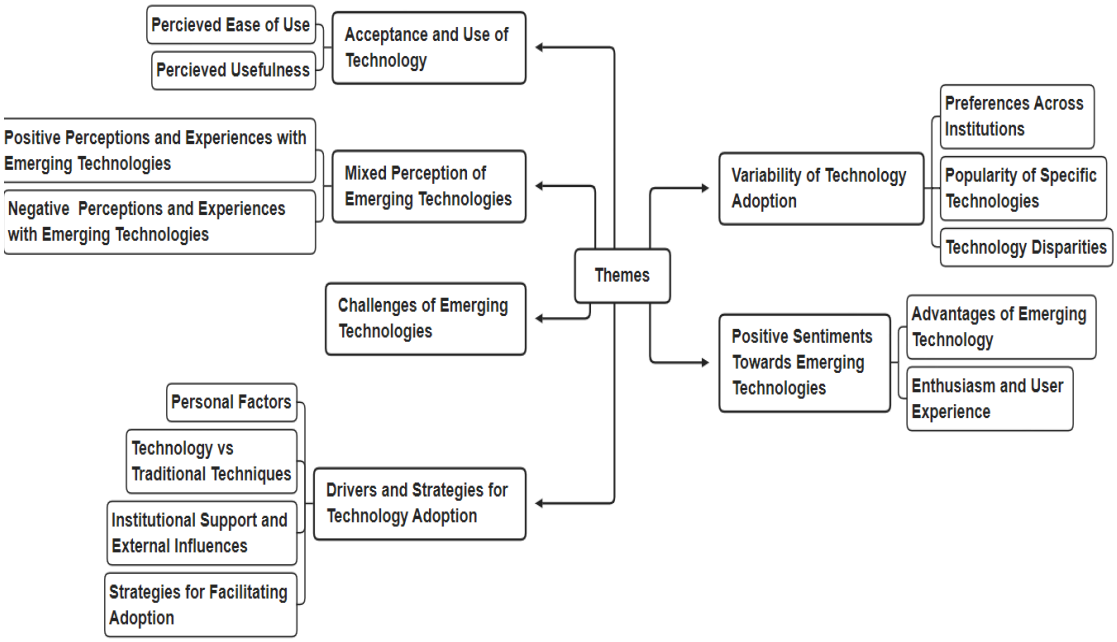

Figure 2: Themes and Subthemes from Interview Data Analysis

Sourced (Author, 2023)

4.3.1 Variability in Technology Adoption

Variability in technology adoption was identified through the interviews. This allows us to gain a deeper insight into the nuanced experiences and attitudes of participants in understanding the impact of emerging technologies on MET. Among the interview questions listed in appendix A, the participants described the experience in both thoughts and feelings. Participants expressed a high level of interest in the integration of emerging technology.

Participant 1,

> ‘‘But with technology, it has actually been possible to train people across the world. They can be sitting in different places, and they can still do the simulator training.”

‘‘…sometimes are not able to connect or focus, but when we can present certain technology-driven visuals to them, they are more able, they are in a better position to connect with the subject and a better understanding.”

Participant 2, “…. the IoT is very good for maritime education and training in the future because the things that are being learned and being talked about in one part of the globe can also be utilized in other parts of the globe.”

Participant 7, “…. most of the seafarers I've worked with say that it is much safer to sail now because of the technology”.

4.3.1.1 Preferences Across Institutions

Preferences Across institutions was identified as a subtheme identified through the interviews and observations. The use of emerging technologies varies across institutions, countries, and maritime contexts. Technologies are being used for simulating vessel navigation and operations, cargo operations, and safety procedures and “… introducing the maritime role” (Participant 2). Some institutions also use emerging technologies like the LMS to facilitate synchronous learning and generate learning content like AI-generated images and video lectures, discussions, and draft templates for learning activities.

Participant 2 noted that MET trainees are using “… ChatGPT to ask questions about their field, their study…” and “to confirm if something that they know or something that they have read is true.” Some instructors, like Participant 3, use these technologies for behavioral analysis, improving situational awareness, simulating ship operations, provisioning resources to students, and assessing student understanding, success, and knowledge retention.

However, participant 1, stated that “.... from the institution trainees like traditional methods of teaching due to lack of technological know-how…. “they are not computer inclined”.

Overall, an emerging consensus is that these technologies are crucial for aiding in "students' retention of information and improvement of knowledge" (Participant 5).

4.3.1.2 Popularity of Specific Technologies

Simulator technologies like VR and AR are the most common technologies being used by participants in different contexts and roles, followed by e-learning systems and LMS. Blended learning and IoT are also some of the popular technologies being used across MET contexts and institutions.

However, Participant 1 noted that while "… only e-learning, VR, LMS, AR are very well accepted…". In the Philippines, "AI, machine learning, and Internet of Things is not yet very much prominent… in the (Participant 2). Nonetheless, to be effective, these technologies are often used in conjunction with complementary technologies and resources like remote sharing applications like TeamViewer, VR technology like Oculus, Kahoot, video conferencing technologies like Zoom, Kongsberg cloud simulators, and LMS like Moodle, Blackboard, and Module e-learning. Other complementary technologies include the Lockdown browser, ChatGPT, and presentation tools like PowerPoint. Also, the usage frequency varied across institutions and participants. For instance, Participants 1 and 2 reported using a lot of new technologies facilitate their teaching. Unlike Participant 5, who viewed the emerging technologies as "a new thing" for her institution.

Participant 7 states that their typical learning environment is highly digitalized with "… plenty of simulators."

4.3.1.3 Technology Disparities

Disparities in adopting different types of technologies were associated with a gamut of geographical, individual, technological, and institutional factors. For instance, Participant 4 stated that the use of advanced and novel technologies like AR is a new experience for MET institutions in Africa, especially in Nigeria, that requires a strategic

shift in how MET policymakers and decision-makers view, plan, and execute MET policies.

Also, according to Participant 5, the belief that the technologies are "… more efficient and more accessible" is a significant driver of integration. Lastly, the extent of peer influence and support also played a fundamental role in influencing technology adoption. Participant 1 reported having "… a very nice system of value addition over here wherein we actually attend each other's classes."

Similarly, Participant 6 said they were "… just helping each other to learn how to use" the technology. Participant 7 stated they were constantly learning from each other how to use the technology.

4.3.2. Positive Sentiments Towards Emerging Technologies

4.3.2.1 Advantages of Emerging Technologies

Participants expressed positive perceptions and attitudes towards emerging technologies by highlighting the myriad of advantages associated with the use of emerging technologies in MET for learners, instructors, institutions, and the industry. With these technologies, learners are "… in a better position to connect with the subject and a better understanding of it" and "able to understand the subject a lot much more in a better way" (Participant 1).

"Emerging technologies improve convenience (Participant 7) and allow learners to "create their own scenarios" and learn in "a peer kind of exchange format" (Participant 3). The emerging technologies have also been a "… a very big help for the instructors" (Participant 2 and Participant 5), enhanced training effectiveness, reduced the burden on instructors, improved the connection with students, improved creativity, and resource access among instructors, and reduced the workload (Participant 3) and man-hours (Participant 4).

Institutional benefits include enhanced training effectiveness (Participant 1), cost-efficiency (Participant 5), access to learning services (Participant 4), and providing alternatives to traditional learning (Participant 6). These technologies benefit the industry by improving safety and seafarer competency (Participant 1; Participant 3).

4.3.2.2 Enthusiasm and User Experience

Overall, participants were enthusiastic about using these technologies and had a positive experience with them. Participant 1 loved to use these new technologies, Participant 2 thought "… these technologies are very helpful tools" and was positive about using them, Participant 3 believed these technologies have been "… embraced well by the new generation," and Participant 7 was "… very fond of using this technology." The participants also expressed caution and hesitancy in using these technologies. According to Participant 1, "… until and unless the system becomes completely robust, we cannot completely rely on them." Participant 1 cautioned against replacing the conventional methods entirely. Participant 2 expressed concerns about the possibility of having "… a very genius AI that can take the place of an instructor," while Participant 3 expressed their concerns about this technology, stating that "… things are going very fast; the pace is too high." Participant 6 stated that these technologies "… cannot replace these critical experiences."

4.3.3 Drivers and Strategies for Tech Adoption

4.3.3.1 Personal Factors

Personal factors included poor economic background, old age, lack of digital literacy skills, internet access, motivation, and effort to learn the new technology. Prior exposure to and experience with related technologies through curriculum, content, and computer development positively influenced the propensity to adopt new technologies. Participant 3 stated that "utilizing these technologies required extra effort, and older users were less likely to embrace these new technologies than the younger generation. Unlike Participant 2, he believed he was "… very knowledgeable and very fast in learning how to use the technologies". Commitment to continuous research, development, and self-

improvement was key to embracing novel technologies. As Participant 4 states, "… definitely, you know, no network, you cannot do any research, no development." Internet access, access to the right technology like laptops, and digital literacy emerged as the significant individual factors responsible for the disparities in the usage and adoption of emerging technologies among participants. Technological factors included the scalability of the technology and reliability of the network infrastructure.

4.3.3.2 Technology vs Traditional Method of Teaching

There is a generally positive attitude towards and trust in emerging technologies. Participant 2 stated, "I am very appreciative of how these technologies are very helpful for me as an instructor." Participant 3 emphasized the need to respond "… to technology solutions positively, but always with caution," as well as the need to improve those technologies to benefit instructors and their learners. Concerning preference for traditional versus technology-driven methods, participants learned more about a complementary approach where emerging technologies were used to supplement traditional approaches. While these technologies have "… has an overall advantage" (Participant 2), they should "… not replace the conventional thing completely" (Participant 1). They should be used as supplements to each other (Participant 4), and the technology-human integration must be maintained (Participant 5).

4.3.3.3 Institutional Support and External Influences

External influences like the ramifications of the global COVID-19 pandemic and IMO policies also drive technology adoption (Participant 1). The COVID-19 pandemic accelerated technology adoption because "… the mode of teaching shifted from the classroom, the traditional classroom teaching, to online teaching" (Participant 2). IMO, policies like internship opportunities and policies regarding electronic marine highways (Participant 3) have favoured technology adoption. Participant 4 "… was also privileged to go to IMO for internship for a month plus…" and attended online courses by the IMO through Lyndell – an online learning platform. According to Participant 7, efforts "to

meet the standards of the international maritime organization" were influential in implementing simulator technologies and e-learning in their institution. Institutional support, including workshops and 'train the trainer' programs (Participant 1), investing in competent faculty and a robust learning structure (Participant 2), political will (Participant 4), support from faculty (Participant 5), institution-wide perception of emerging technologies as supplements to traditional approaches (Participant 7), was influential in driving up the adoption of emerging technologies in MET practice. For Participant 3, their institution was "… happy to spend money and budget.".

4.3.3.3 Strategies for Facilitating Adoption

MET institutions are using different strategies to promote or facilitate the adoption of emerging technologies in MET. For Participant 1, their institution emphasizes more on the practical aspect of seafarer training, runs campaigns, uses case studies, and leverages interactive sessions. Seminars, workshops, evaluating student and instructor feedback on technologies, studying policy papers regarding technologies like AI, and continuous research on LMS and related technologies work for the institution where Participant 2 is an instructor, Participant 3 stated their organization prefers to "adapt at several stages" and leverage collaboration with relevant stakeholders, stating that they "have to think together in a team about how optimally we can use those technologies to benefit ourselves and our students." Other strategies include building synergy through collaboration and team approach (Participant 4), mandatory 30-40 hours of continuous professional development training (Participant 3), and familiarizing users with new technologies before they are required to use them (Participant 7).

4.3.4 Technology Adoption and Acceptance

This theme identifies the experiences, attitudes, and behaviors of participants regarding the acceptance and practical utilization of emerging technology viewed through the lens of TAM. The participants' attitude was influenced by two factors -perceived ease of use and perceived usefulness.

4.3.4.1 Perceived Ease of Use

Factors influencing the perceived ease of use of technology included flexibility, intuitive interfaces, the level of training required before using the technology, and the efficiency of user support. Participant 1 noted that the technology should be sufficiently flexible to transition towards a more robust system. Regarding intuitive interfaces, participants emphasized a graphical system (Participant 1), user-friendliness (Participant 2), user-friendly content format (Participant 3), and proper design (Participant 6). Training was a key element of the perceived ease of use of the new technologies. Participant 1 stated their implementation was "… a little slow so that once the system also becomes robust and the person also becomes completely trained and knows how to use it." Participant 2 highlighted the number of hours needed to learn emerging technology, while Participant 3 stated that "… the advent of … technology … was problematic for the teaching staff," without proper training. User support was also crucial in determining perceived ease of use. According to Participant 1, "… support from the shore or support from the providers of some technology" was important in determining whether a technology was appropriate for the MET use case.

4.3.4.2 Perceived Usefulness

Participants expressed general positive perceptions or feelings regarding the potential and benefits of emerging technologies in MET practice from the third interview question (see appendix A). Participant 1 stated that using "emerging technology this way has become really helpful." Participant 2 stated that these technologies were very useful, helpful, and good for students and instructors. Participant 2 stated they had "… positive feelings when it comes to using these emerging technologies." Participant 3 stated that "the benefit of technology is more than its flaws," and believed there were "helpful to instructors and opportunities … to let the students use those AI-based, like CHATGPT." Participant 4 stated that "… it's actually helped me a lot… very helpful". Participant 5 asserted that these technologies were "…. helpful and reduce stress". Participant 6 emphasized that there is "an opportunity for us to bring something new and maybe

motivate others to try something… innovative". Participant 7 asserted that “this emerging technology is very powerful …” and helpful (see Figure 3).

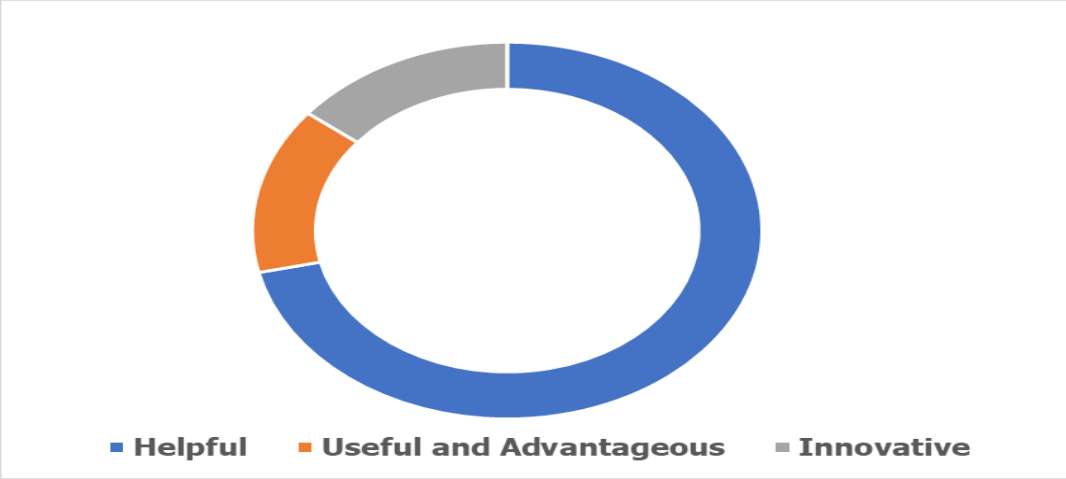

Figure 3: Descriptive categories of participants' feelings about E T

Sourced: (Author, 2023)

All participants had a strong positive perception of the usefulness of emerging technologies for MET practice. Emerging technology was perceived to be useful in MET because it enhances learning, improves training outcomes, fosters better access to knowledge and information, and increases the efficiency of MET processes. Novel technologies like simulators, VR, AR, AI, ML, and big data can enhance training effectiveness, understanding, performance, and behavior (Participant 1); supplement conventional methods, improve access to resources, and prepare seafarers for the job at sea (Participant 2); and makes seafarers to be more knowledgeable (Participant 7). The participants also believed these technologies were revolutionary game changers with big opportunities for MET instructors and trainees alike. Participant 6 stated that these new technologies “… serve as an alternative for us to learn continuously.” Participants also perceived these technologies to improve learning outcomes by augmenting understanding, reaction times, and knowledge retention, and helping students and instructors interact more productively.

According to Participant 6, the technologies make maritime trainees more knowledgeable, confident, competitive, skilled, familiar with their field, and able to

communicate well with others. All participants stated that this new technology was useful, advantageous and helpful because it promotes or improves access to learning content and critical knowledge for both instructors and trainees. These technologies also increase the efficiency of maritime training and operations by enhancing training effectiveness (Participant 1), reducing the duration of training significantly, supplementing conventional teachings (Participant 2), making instructors more efficient and reducing their workload (Participant 3), and "promoting efficient operations on board" (Participant 6). Participant 5 stated that these technologies have a "… positive impact, and I like it, and it makes things easier."

4.3.5 Mixed Perceptions of Emerging Technologies

4.3.5.1 Positive Perceptions and Experiences with Emerging Technologies

All participants had a strong positive perception of the usefulness of emerging technologies for MET practice. Emerging technology was perceived to be useful in MET because it enhances learning, improves training outcomes, fosters better access to knowledge and information, and increases the efficiency of MET processes. Novel technologies like simulators, VR, AR, AI, ML, and big data can enhance training effectiveness, understanding, performance, and behavior (Participant 1); supplement conventional methods, improve access to resources, and prepare seafarers for the job at sea (Participant 2); and makes seafarers to be more knowledgeable (Participant 7). The participants also believed these technologies were revolutionary game changers with big opportunities for MET instructors and trainees alike. Participant 6 stated that these new technologies "… serve as an alternative for us to learn continuously." Participants also perceived these technologies to improve learning outcomes by augmenting understanding, reaction times, and knowledge retention, and helping students and instructors interact more productively.

Participants expressed positive perspectives and experiences regarding emerging technologies like AI, particularly ChatGPT. Positive experiences included making work easier (Participant 2), improving behavior and performance (Participant 1), positively

impacting teaching and content delivery (Participant 3), making knowledge available (Participant 4), convenience (Participant 7), and facilitating continuous discovery and discussion (Participant 5). Participants expressed general positive perceptions or feelings regarding the potential and benefits of emerging technologies in MET practice.

4.3.5.2 Negative Perceptions and Experiences of Emerging Technologies

Common issues reported by participants included misuse of technologies and over-reliance. According to Participant 1, "… the students are abusing these technologies in order for them to get ahead with the tasks of their day …," including completing exams and assignments, "… leaving the responsibility to these technologies". "Somehow, I have seen that candidates are becoming more reliant on finding information. they are not able to retain that knowledge for very long and suppose they learn something today; they will be going back to the source, and you know checking that source and then again get that information repeatedly and they're not trying to retain that thing in their mind".

Participant 3 also noted the issue of over-dependence. According to Participant 2, "Instructors are also over-reliant with these technologies." Leaving the responsibility for MET with these technologies can suppress creativity and ingenuity among instructors. Participants also reported negative experiences with these technologies, including poor scalability, overdependence (Participant 2), limiting creativity and originality…. destroying the academic knowledge of the instructor (Participant 2) and having to use poorly developed systems (Participant 6). Participant 2 perceived these emerging technologies in a negative light as he believes the student pace of development is fast"….. it gives them a negative pace of their development, they are developing very quickly, and that means someone not walking but running.

4.3.6 Challenges of Emerging Technologies.

Several issues reported towards effective implementation of emerging technologies include poor or no internet access, technical support for training, and epileptic power supply. Participant 1 mentioned economic background is another challenge to emerging

technology “some economically challenged backgrounds don't have access to the equipment that is required to be there with them for attending those trainings”.

Participant 6 and Participant 4 reported poor or limited internet access as a major technological challenge associated with the integration of emerging tech in MET. Equally important, Participant 4 added, “..... epileptic power supply, and lack of facilities to support training (Participant 4), technical glitches or bugs (Participant 1), and unfamiliarity with emerging technologies like AR, VR, ML, and AI in MET (Participant 6).

4.4 Summary Findings and Interpretations

Findings from the analysis highlight critical aspects of the nexus between emerging technologies and MET, including the variability in adopting emerging technologies, generally positive sentiments towards technologies, mixed perceptions towards emerging technology, drivers and adoption strategies, acceptance and use of technology (TAM) and benefits of emerging technologies in MET. Research questions have organized the findings.

4.4.1 The first research question is: What are the perceptions of MET instructors and trainees about emerging technologies?

With the rapid technological advancement in the maritime sector, understanding the views, concerns and expectations of MET instructors and trainees regarding to technological advancement is key. From the interview data analysis, significant variations in emerging technologies adoption across MET institutions, countries, and maritime contexts were noted. Simulator technologies like VR and AR, e-learning, and LMS were the most widely accepted technologies. Participant 4 stated that the use of advanced and novel technologies like AR is a new experience for MET in Nigeria. This variability underscores the complex nature of technology adoption within MET and highlights the need for context-specific considerations when implementing emerging technologies. Secondly, participants expressed positive sentiments towards emerging technologies in MET. They identified numerous advantages associated with these

technologies in agreement with previous literature, including improved learning outcomes (Dewan et al., 2023), enhanced access to learning materials (Chae et al., 2021), better student performance (Fan & Yang, 2023; Mallam et al., 2019), and increased competitiveness (Fracaro et al., 2022; Jensen & Konradsen, 2018). While some participants believe technology is a significant enabler of learning and teaching in MET, others expressed concerns that they might hinder creativity, retention, attention span, and originality. These mixed perceptions highlight the complex interplay between innovation and educational practices in the maritime context. Similarly, MET instructors and trainees considers that innovative teaching techniques like simulation training and virtual reality experiences help students retain information and enhance their skills in navigation, engineering, and cargo handling. These positive perceptions suggest that emerging technologies are seen as valuable tools that have the potential to enhance MET practices and outcomes.

Lastly, the enthusiasm of MET instructors and trainees for emerging technologies was evident – many participants expressed a genuine interest in utilizing these new tools to enhance their learning or instruction. However, alongside such enthusiasm, technology should serve as an accompaniment of pedagogical methods instead of supplanting them. Therefore, it is important to accept technological innovation while maintaining the traditional aspect of MET until these emerging technologies become robust and self-sufficient.

4.4.2 The second research question was: What are the attitudes of MET instructors and trainees toward emerging technologies influencing MET practice?

As technology reshapes the maritime sector, the attitudes of those directly involved in MET can influence its adoption and effectives. Participant attitudes toward emerging technologies in MET practice ranged from enthusiastic embrace to careful consideration of these technologies for MET practice. First, a dominant theme among participants was a positive attitude toward integrating emerging technologies into MET as it creates an enabling and engaging learning environment for knowledge creation and promotes active participation among trainees. While participants describe emerging technology

as a very useful tool, they also caution about the possibility of over-reliance on technology, arguing that overdependence could diminish the role of the instructors and the trainee's critical thinking aspect.

Towards adoption of these technology participants shed light on why we should not blindly drop the conventional part and jump to AI so soon because it will take a lot of time for the new technologies to become robust and the new technologies to become self-sufficient. Participants believe that it is also important for systems to be in place for self-diagnosis, self-test, and repair and until and unless the system becomes completely robust, they should not completely rely on them. Consequently, transformation should be done at a slower pace where the user end is aware of the shortcomings and the user end is aware of the issues that it can have. Therefore, these technologies should be thoroughly tested to ensure they are robust and ideal for promoting learning in the MET context.

4.4.3 The third research question was: What are the experiences of MET instructors and trainees with emerging technologies in MET practice?

Participants had positive and negative experiences with emerging technologies in MET. Positive experiences associated with integrating emerging technologies in MET were a dominant theme among participant narratives. In concert with existing literature, the positive experiences associated with integrating emerging technologies in MET include enhanced learning experiences (Kim et al., 2023; Mallam et al., 2019), improved access to content and resources (Chae et al., 2021), and improved productivity (Dewan et al., 2023; Hjelmervik et al., 2018). Participant noted that these technologies facilitated a deeper understanding of maritime concepts, promotion of students-instructor engagement, as well as the possibility of personalizing scenarios were some of the positives of technology in MET practice. Participants express great pleasure with their experiences with integrating technology into MET to replicate real-world maritime scenarios. Thereby improving seafarer competency and preparedness for onboard operations. Moreover, the convenience of remotely accessing learning materials and resources was highlighted as a significant advantage.

Lastly, the study also revealed several challenges and limitations associated with integrating emerging technologies in MET, including misuse of technologies, network connectivity, technical problems, and power shortage. Participants identified the misuse of technologies, such as using them to circumvent academic responsibilities, as a potential drawback. Adverse experiences also resulted from technical challenges, including network connectivity issues and technical glitches. Hence, there is a need to tackle the various issues and work towards implementing effective solutions by education authorities. The participant establishes the fact that emerging technology is a highly useful tool. However, they pointed out that over-reliance on this technology could hinder trainees' critical thinking skills, reduce retention, attention span, and reduce the importance of instructors.

4.5 Summary of Chapter

These findings illuminate a highly dynamic landscape of perceptions, attitudes, and experiences among MET instructors and trainees regarding the integration of emerging technologies in MET. The positive sentiment towards emerging technologies and their potential benefits in MET was evident from the interviews, with participants highlighting advantages such as improved learning outcomes, safety enhancements, and collaborative opportunities. However, the variability in technology adoption across institutions and the mixed perceptions of specific technologies, acceptance, and use of technology (TAM) emphasize the intricate nature of technological integration in complex ecosystems like MET. Personal factors, institutional support, and external influences emerged as significant drivers of technology adoption, underlining the need for a holistic approach to facilitating this transition. The findings also underscore the critical importance of strategies for promoting technology adoption and the multifaceted benefits of emerging technologies in enhancing MET practices for the future.

Nevertheless, challenges and limitations exist, and addressing issues, such as extensive training requirements and concerns about creativity, is a policy imperative. Notably, the mixed perceptions surrounding AI technology, exemplified by mixed attitudes and perceptions regarding AI technologies like ChatGPT, reveal the complex interplay

between innovation and educational practices in the maritime context. These findings collectively contribute to a nuanced understanding of the evolving MET landscape and its adaptation to the digital age. The next chapter presents an elaborate discussion of these findings.

Chapter 5: Summary and Conclusion

5.1 Introduction

Like all other industries, technology has played a fundamental role in influencing outcomes in the maritime industry. Emerging technologies like AI, VR, AR, ML, IoT, e-learning, and LMS have significantly influenced MET processes. Even though these technologies have become more ubiquitous over time, the perceptions, attitudes, and experiences of users, particularly MET instructors, and trainees, have not been sufficiently explored. This study sought to fill this gap by exploring the intricate interplay between technology and maritime education and unravelling the multifaceted perspectives emerging within this dynamic context using a phenomenological study through the lens of technology acceptance model. This chapter summarizes the study's model of technology use, implication, recommendations for MET policy and practice, and suggestions for further research.

5.2 Model of Technology Use

TAM was used as a model of technology use to guide the study. The technology acceptance model (David, 1986) is composed of perceived ease of use, perceived usefulness, and attitude towards technology. Perceived usefulness played an important role in technology adoption. Participants in the study shared their view on emerging technology as useful, helpful, and advantageous to enhance their overall training and learning process. Participants also perceived these technologies to improve learning outcomes by augmenting understanding, reaction times, and knowledge retention, and helping students and instructors interact more productively.

According to Participant 6, the technologies make maritime trainees more knowledgeable, confident, competitive, skilled, familiar with their field, and able to communicate well with others. This positive attitude and willingness to embrace technology exemplify one end of the adoption spectrum. Technology was useful to them as it helps to project real-life scenario and perceived to be beneficial for students who

have yet to have hands-on experience on vessels or ships, making it easier to understand complex ship structures and machinery. Participants highlighted that e-learning and LMS have made instructor's jobs easier by providing readily available learning materials and structured courses which allows instructors to focus on guiding students on how to use these platforms effectively. Regarding VR and AR, participant 3 emphasizes their significance in providing visual representations and multi-level presentations on ships. These emerging technologies enable instructors to demonstrate and explain intricate machinery and ship operations more effectively to students which is deemed useful to their teaching and learning.

Additionally, participants shared that they used technologies they were familiar with, and this supported the view of perceived ease of use. Participants 5 stated that she is only familiar with the LMS in her institutions because that is what she always uses to aid her studies. Participant 4 stated that the use of advanced and novel technologies like AR is a new experience for MET in Nigeria, however, this will be a double- edge sword affecting perceived ease of use as they are not familiar with such technologies. The interview analysis showed that technology plays an important role in MET as the merit overweighs the demerit with vast utilization.

5.3 Implications

The findings of this study have profound implications for MET as they reinforce the mainstream perception and understanding of the adoption, experience, and perception of emerging technologies by MET instructors and learners. The findings reveal the potential of emerging technologies to substantially augment MET outcomes by enhancing training efficiency and improving accessibility, as well as making maritime operations safer. Despite these positive implications, the findings also underscore the significance of remediating issues like network limitations, misuse of technology, and concerns for over-dependence on technologies. The inherently mixed perceptions and attitudes towards novel technologies like AI-based platforms like ChatGPT accentuate the dire need for a careful integration of emerging technologies into MET programs to ensure that they complement classical methods and systems and provide value to

learners and trainers. Overall, findings from this study provide valuable insights into the mainstream perceptions, attitudes, and experiences with emerging technologies, including the myriad opportunities and challenges associated with these technologies in MET practice. Insight gleaned from these findings can support informed decision-making and evidence-based strategic planning to advance and sustain MET practices.

5.4 Recommendations

Findings from this phenomenological study have indispensable implications for MET policy and practice. First, MET leaders must foster or cultivate a positive technological culture in MET institutions. The overwhelmingly positive sentiments towards emerging technologies in MET from the interviews suggest that MET leaders should actively foster a culture that embraces technological innovation, for instance, by organizing technology showcases, workshops, and training programs to keep MET practitioners abreast of the latest advancements and their influence on MET. Cultivating a positive technological culture would enable institutional leaders to harness the prevailing enthusiasm for innovations and novel technologies that drive constant enhancements in MET practices in a manner that benefits MET institutions, instructors, and trainees.

The second recommendation is that the strategies for technology adoption should be tailored to the unique contexts and circumstances of MET practice. Thus, MET leaders should advance context-specific strategies and policies for technology integration by conducting technology readiness assessments to identify institution-specific needs and preferences. Tailoring these technology integration approaches allows MET policies and practices to accommodate intrinsic structural, functional, and cultural variances. Such adaptation would ensure that the technology aligns with the unique context of the MET environment in which its use is intended to optimize its effectiveness. The third recommendation is that MET institutions and leadership need to prioritize providing resources, training, and support for MET practitioners to facilitate seamless and efficient adoption and integration. Institutional support should extend beyond technology acquisition to include ongoing professional development and technical assistance after integrating the new technology. Policymakers should also collaborate more with MET

institutions to develop policies and provision funding and support mechanisms that foster a conducive environment for technological advancements in MET.

The fourth recommendation is that MET leaders need to proactively address the limitations and challenges associated with emerging technologies in MET practice. For instance, MET leaders must invest in robust user training programs to mitigate the extensive training requirements associated with new technologies. It is also imperative for MET leaders to constantly explore novel and multifaceted solutions for enhancing creativity and originality within tech-driven MET contexts. These leaders also need to implement measures to ensure a balanced approach to technology integration that preserves the essence of maritime education. Finally, the mixed experiences, perceptions, and attitudes of MET trainers and trainees, including the potential of the technology to influence learning and creativity, create an imperative for MET leaders to develop and adopt a judicious approach to integrating these technologies. In doing so, policymakers must invest in research and pilot projects designed to explore the most optimal use of such technologies in MET, including their specific applications, potential benefits, and limitations. Moreover, systemic collaboration between MET institutions, policymakers, and regulators can embolden the efforts to develop robust and context-specific guidelines and standards for the ethical and effective utilization of these technologies to enhance learning experiences and outcomes.

5.5 Suggestions for Further Research

The purpose of this study is to examine MET instructors and trainees' diverse perspectives influencing emerging technology through the lens of technology acceptance model (TAM). The study has shown the potential of the phenomenological approach which is instrumental for further longitudinal studies on technology adoption and adaptation trends necessary to fill existing knowledge gaps in the attitude, experience, and perception of emerging technologies in MET. The swiftly evolving nature of technology makes longitudinal studies to track the trends in technology integration over time a research imperative. Further studies investigating how MET institutions evolve in adopting or adapting emerging technologies could provide

valuable evidence-based insight for leaders and policymakers. For example, such studies could identify the best practices and areas that need improvement to facilitate the development of highly dynamic and responsive MET policies. Secondly, the interspersed perceptions regarding AI technologies in the MET context imply that further research must focus on comprehensive investigations into the integration of specific AI tools, like ChatGPT, within MET practice and curricula. Further research is needed to explore the effectiveness of AI-driven learning environments, their impact on student engagement and outcomes, and strategies for optimizing their use while mitigating concerns about their potential drawbacks.

Thirdly, additional studies on emerging technologies beyond AI are needed to expand mainstream knowledge and literature. Even though this phenomenological study focused on emerging technologies like AI, VR, ML, AR, e-learning, and LMS, future research could explore the integration and impact of other cutting-edge technologies in MET, such as blockchain, 3D printing, among others. Further investigations into these technologies could provide a thorough understanding of the ever-expanding technological landscape and their potential contributions to MET. Fourthly, building on the benefits and limitations theme, future research could delve into the student-centered approaches in technology-driven MET. For instance, further research is needed to examine how technology can be leveraged to promote active and personalized learning experiences for MET learners. These studies could highlight what strategies effectively ensure students remain engaged and motivated in technology-intensive environments. Research in this area could enhance mainstream understanding of pedagogical and tailored approaches within the context of emerging technologies.

Finally, as technology becomes increasingly inherent to MET practice, future research should explore the role of regulatory bodies and the development of industry standards in guiding technology integration. Such studies could investigate how these regulations and standards influence the adoption of emerging technologies to ensure that MET practices are aligned with the industry. Also, the maritime industry's growing emphasis on sustainability creates a gap for further studies to explore the environmental impacts

of technology integration in MET, including the influence of emerging technologies on environmental practices within maritime education and the industry at large. Research in this area could contribute to sustainable technology adoption strategies and practices.

5.6 Conclusion

The phenomenological study is instrumental to phenomenon being investigated through the lens of TAM. Comparatively, the study reveals the critical need for MET leaders to navigate this evolving landscape judiciously, considering context-specific approaches, addressing limitations, and fostering a culture of innovation. The significance of these findings is threefold. First, they provide valuable insights for MET leaders by offering guidance on harnessing the benefits of emerging technologies while mitigating their challenges. Second, the study underscores the strategic importance of technology in education and practice by emphasizing the transformative potential of technology in the maritime industry. Lastly, the findings are relevant to society, as a technologically equipped MET sector can contribute to a safer, more efficient, and sustainable maritime industry.

5.7 Summary

This qualitative phenomenological study aimed to explore the perceptions, attitudes, and experiences of MET instructors and trainees regarding the influence of emerging technologies on MET practices and outcomes. The findings have shed light on the complex nature of technology integration in MET, including positive user impressions and mixed perceptions regarding the utility and value of these technologies in MET. The qualitative data analysis yielded several key themes, including positive sentiments towards emerging technologies, variability in technology adoption, drivers and strategies for tech adoption, mixed perceptions of AI technology, and the strategies for facilitating technology adoption. Based on these findings, an overarching conclusion from this study is that technology is becoming increasingly integral to MET and is embedded with the potential to enhance learning outcomes, safety, and efficiency within the maritime industry.

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Appendices

Appendix A: Interview Instrument

Dear Respondent,

I hope this email finds you well. I am Beauty Ebiere MAGHOROMI, a postgraduate student from the World Maritime University (WMU), specializing in Maritime Education and Training (MET). I invite you to participate in a research study on the Impact of Emerging Technologies on Maritime Education and Training.

The study aims to investigate the influence of emerging technologies such as E-learning, Virtual Reality (VR) Learning Management Systems (LMS), Augmented Reality (AR), Artificial Intelligence (AI), Machine Learning (ML), the Internet of Things (IoT) from experienced Maritime Education and Training instructors and trainees through a three series of online or in-person in-depth phenomenological interviewing lasting 60-90 minutes and scheduled at your convenience which will be done in sequence:

1. The first interview will seek valuable insight into the participant's past experiences with the phenomenon being investigated.
2. The second interview dives into the concrete details of the participants' present lived experiences
3. The final interview allows participants to reflect on their experience, making sense of their feelings, thoughts, and impacts on their lives.

You can withdraw anytime, and participation in this study is voluntary. Please respond to this email if you require additional information about the study, and I will be happy to provide a prompt response.

We appreciate your willingness to participate in our research on Maritime Education and Training research. Your valuable input can significantly enhance our understanding of the subject matter and support further advancements in this field.

FIRST INTERVIEW: This interview seeks valuable insight into the participant's past experiences with the phenomenon being investigated.

1. Could you please share your role and a brief history of your involvement in Maritime Education and Training

2. Previously, what technologies have you used in teaching/learning?

3. Could you please share your experience on how you initially responded to the integration of technologies in your MET experience?

4. How have past experiences shaped your attitudes toward technology in Maritime Education and Training?

SECOND INTERVIEW: Details in the Experiences: This dives into the concrete details of the participants' present lived experiences

1. Could you describe a typical teaching/ learning session using emerging technologies? I would greatly appreciate a comprehensive breakdown of the process.

2. Could you share a particular instance where the use of emerging technologies significantly impacted your teaching /learning?

3. What are the challenges or successes you have encountered with using this technology

4. Can you talk about any strategies you have adopted to optimize the use of these technologies

THIRD INTERVIEW Reflection on the Meaning (Reflection on the Experience): The final interview allows participants to reflect on their experience, making sense of their feelings, thoughts, and impacts on their lives.

1. How do you perceive the changes these technologies have brought to your teaching/learning environment – (How has it changed your perception of MET) OR "How has your perception of MET changed?"

2. What are your feelings about the use of emerging technology in your MET experiences

3. Based on your personal experiences, how would you describe the readiness and acceptance within the maritime sector for these technological shifts in education and training?

4. How has your understanding of MET changed with the integration of emerging technologies?

5. What are your concerns, expectations, or perspectives on how the integration of emerging technology will shape the future

CLOSING QUESTIONS

Would you like to share additional insights about your experience integrating technology into maritime education and training? Additionally, do you know of other individuals or institutions with unique backgrounds in MET that could be valuable for further research.

Appendix B: Coding Sheet

Name	Description	Files	References
Application or uses	How are emerging technologies being used or applied in MET?	3	4
Complementary tech or apps	Support technologies that help MET instructors and learners to adopt emerging tech	5	29
how technologies are being used	How are technologies being used in MET - videos, simulations, online content, etc	5	36
types of technologies - AI, VR, etc	What technologies are they using - e-learning, AR, VR, etc	5	35
Usage frequency	How often to participants use emerging tech in their practice?	5	16
Attitudes	Positive, negative, and mixed attitudes towards emerging tech in MET	0	0
Excitement about tech	Negative user attitudes towards emerging tech	5	21
Preference (traditional vs. tech)	Whether the interviewee prefers traditional or technology-based methods.	4	13
Resistance or hesitancy	Positive attitudes towards emerging technologies	4	11
Trust in technology	Whether users trust emerging tech in MET	5	26
Benefits	Benefits of emerging tech in MET	3	28
Industrial	Benefits to the maritime industry	5	25
Institutional	Benefits to MET institutions	3	7
To learners	Benefits to individual learners	5	59

Name	Description	Files	References
To trainers	Benefits to MET trainers/instructors	5	41
Challenges or barriers	Challenges/setbacks/drawbacks of integrating emerging tech in MET	0	0
External	Challenges that are external to MET institutions - policy, global trends, etc	1	2
Individual	Barriers or challenges inherent to individual learners and instructors	5	32
Institutional barriers	Institutional incentives or barriers that hamper the implementation of emerging tech in MET	3	11
Technological barriers		4	8
Common issues (most cited)	Problems most commonly experienced by users	0	0
Misuse		3	4
Network issues		4	35
Over-dependence	Overreliance on technology among MET instructors and students.	3	13
Technical issues		4	5
Drivers of tech adoption	Do MET trainers and trainees actually use emerging technologies in their work? What factors drive the integration or adoption of emerging tech in MET? Address the personal/individual, institutional, policy, legislation, etc.	0	0
External mandates or pressures	Things like legislation, laws, and policies passed by the government or the IMO	4	11
Institutional support		5	30
Peer attitudes and influence		1	1

Name	Description	Files	References
Personal factors	Personal factors influencing the desire to adopt or use tech, including prior experiences with technology, self-efficacy and confidence, openness to change, or personal motivations like career advancements or curiosity.	5	46
Resource availability		5	30
Experiences	Experiences with emerging technologies	0	0
Negative	Frustrations, anxieties, exasperations, and bad experiences with tech	4	11
Positive	Whether tech has helped	5	30
Future perspectives	How interviewees think these technologies will be in the future, including expectations for advancements, desired additions or improvements, concerns about overreliance in the future etc.	0	0
Concerns about tech adoption	Any concerns about future reliance on technology	6	42
Desired improvements	Desired improvements or additions to current technology offering	3	12
Expectations or future outlook		5	32
Noteworthy Quotations	Noteworthy quotations from interviewees that might need to be lifted from the transcripts and onto the Findings chapter.	3	48
Perceptions of emerging technologies	What are the perceptions of MET trainers and trainees of emerging technologies in MET?	0	0
Negative user perceptions	Negative user perceptions of emerging tech in MET	3	6
Perceived ease of use	ow easy do MET trainers and trainees perceive emerging technologies to be to use?	0	0

Name	Description	Files	References
Flexibility	Flexibility of emerging tech for MET	2	2
Intuitive interfaces		5	7
Training required vs. self-explanatory		5	18
User support	Whether technologies have technical issues or glitches that undermine their use.	3	4
Perceived usefulness	How useful do MET trainers and trainees perceive emerging technologies to be for their work?	1	3
Enhances learning		5	22
Game changer		5	17
Improved outcomes		4	30
Improves access		4	35
Increases efficiency		5	41
Positive perceptions	Positive user perceptions of emerging tech	5	59
Usage in MET	Describes the actual use of the technology, including the intention to use and the strategies being used to facilitate the implementation of the technology.	5	48
Integration strategies	What integration policies or strategies are being enforced, adopted, or implemented by institutions?	5	36
Intention to use	Do MET trainers and trainees intend to use emerging technologies in their work?	5	12

Name	Description	Files	References
User training	Training offered to MET trainers and trainees to enhance tech adoption and efficiency of use	4	18