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Research Article

Aligning the Ship Engine Cadets' Skills to the 21st Century

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ABSTRACT

The Philippines is one of the single largest nationality groups in the maritime and shipping sectors; as a result, the nation's efforts to modernize the skills of the engine cadets are significant. This study aimed to assess the engine cadets' skill level in relation to the requisite 21st-century skills while they were receiving shipboard training at TORM Shipping Philippines Inc. It used a sequential explanatory mixed-methods design. The paper used mean, standard deviation, and Mann-Whitney for comparing differences between two independent groups for the statistical treatment analyses of the quantitative data. Thematic analysis of the descriptive data provided by the interviewees involved coding and identifying common themes, patterns, and responses. The findings revealed that the engine cadets were competent in three (3) areas but needed to be more competent in the remaining area (inventive thinking). This signified that the engine cadets need supplemental training in the areas where they are less apt to improve their skills in all variables, especially 21st-century skills. The management of maritime schools and policymakers must address the common factors that prevent engine cadets from acquiring 21st-century skills, according to the study.

Keywords: *Engine cadets, Maritime, Shipboard training, Supplemental training*

Introduction

In today's dynamic marine industry, maritime higher education institutions (MHEIs) struggle to connect academic instruction with practical capabilities (Ivaylo, 2018). It requires each MHEI to establish a good onboard training program to connect their academic curriculum to the ship. New technologies in the workplace, education, and training require adapting the above links for current and future needs. Technology has greatly aided teaching and learning in recent years, especially since the pandemic. However, worries may remain about the execution of a quality academic program, especially the apprenticeship training program of each maritime trainee, which should be the last element in the development of a quality merchant marine officer. When these marine recruits are

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deployed and integrated into the real workplace, questions may arise concerning their skills due to a lack of link between the training program and the workplace. MHEIs may accidentally lack the staff, facilities, and programs to address technology trends in schooling rather than future employment needs.

Thus, the study's goal was to assess maritime engine cadets' skills and identify their potential weaknesses and barriers to 21st-century competency.

Ananiadou and Klaro (2009) define 21st-century skills as "those skills and competencies that young people will need to be effective workers and citizens in the knowledge society of the 21st century." The authors of 21st Century Skills and Competences for New Millennium Learners in OECD Countries discussed the importance and applicability of 21st century skills and competencies before proposing a new three-dimensional framework based on information, communication, ethics, and social impact.

The Partnership for 21st Century Skills described 21st-century skills as "the abilities, information, and expertise that students need to excel in work and life—a combination of content, knowledge, specific skills, and expertise" (Siddiq, Gochyyev, and Wilson, 2017). Both 21st-century skill descriptions require students to learn futuristic and technological talents. Mahmud & Wong (2022b) agree that abilities have been integrated into 21st-century marketable skills using artificial intelligence, big data, robots with augmented reality, the Internet of Things, 3D printing, and block chain. This suggests that 21st-century abilities are important for the younger generation to stay relevant.

Over the last several decades, technological advances have changed ship design, building, and operation in the marine sector. IMO-defined maritime autonomous surface ships (MASS) were introduced in 2017. The IMO decided to update the maritime education and training curriculum due to technological advances. The present curriculum requirements for piloted boats will not be enough to educate seamen on digital ships. Education is crucial to preparing workers for these increasingly digitalized future jobs.

Reza Emad et al. (2022) state that operators must be taught how to utilize new technologies and how to overcome human-technology interactions to be prepared. Marine Engine Cadets must improve their skills to match 21st-century norms. Future workers need the ability to adapt to changing circumstances, according to Habets et al. (2020).

All maritime schools have included shipboard training or apprenticeship in their curriculum, with subject credit units. All marine deck and marine engineering bachelor's students must undergo a one-year apprenticeship or onboard training. The MARINA-administered license test for operational-level officers requires one year or 12 months of onboard training for BSMT and BSMar-E graduates. Kamiski & Charchalis (2019) may doubt if young engine cadets can operate in the engine room at an operational level right after graduation. Thus, despite IMO-required training programs at maritime training facilities and mandatory practical training regardless of study type or location, cadets' capabilities are restricted. This shows that graduates of different MHEIs are unprepared for 21st-century tasks.

To prove this, TORM Shipping Philippines Inc. obtained accreditations and certifications from reputable logistic organizations, third-party certifying bodies, and regulatory agencies. The Head of Global Marine Human Resources at TORM must approve the nominated maritime institutions and assess them annually, at least three months before the cadet's admission. To ensure quality, TORM Shipping Philippines Inc. prefers cadets from trustworthy suppliers.

Care et al. (2018) said that education systems must deliver 21st-century learning experiences and provide new learning areas with transferrable skills and abilities. These graduates' abilities are of great significance to marine employers. "Are graduates equipped with the necessary 21st-century skills to function effectively beyond the classroom?" employers ask. Mahmud and Wong (2022) say critical thinking, digital literacy, and creativity are the most important employability skills. These critical talents correspond with 21st-century skills.

There may be ongoing studies on cadets' shipboard training, but none have investigated

engine cadets' shipboard training abilities and 21st-century skill needs. Job readiness studies are fascinating due to the empirical evidence of a lack of job preparedness. Fataron and Sijabat (2019) found no convincing study on working competence determinants. This research assessed engine cadets' onboard training capabilities against 21st-century competencies, assessed their job readiness and preparation, and developed a shipboard training program to remedy the identified inadequacies.

Theoretical Framework

HCT stresses how education boosts worker productivity and efficiency, according to Almendarez (2013). Increase the cognitive stock of economically productive human aptitude, which is a result of intrinsic talents and investment in people. Almendarez (2013) added that formal education is considered an investment in human capital, which proponents of the theory value more than physical wealth. Human capital is developed through education and includes human characteristics, performance possibilities, the ability to learn and develop, motivation to train others, and shared knowledge and expertise, according to Becker (1964, cited in Cooper & Davis, 2017).

Human capital theory in education boosts productivity by increasing and diversifying the work force. National prosperity comes from human resources. Humans actively collect wealth, utilize natural resources, construct social, economic, and political structures, and advance national development (Almendarez, 2013). Organizations value human knowledge like equipment. Human resources wages show how education affects output and earnings (Cooper & Davis, 2017).

Knowledge-based economies are intrinsically linked to human capital. According to their value or cost to a person, organization, or nation, human capital is the skills and traits that make people productive. Knowledge-based economies need employment diversification as labor becomes less essential. Workers entering the workforce must be able to generate, utilize, and exchange knowledge (Abu-Shawish, Romanowski, & Amatullah, 2021).

Howard (2018) states that preparing knowledge workers and people who can thrive in the "knowledge-based and globalized era" by acquiring 21st-century skills and competencies will boost economic growth and competitiveness for nations seeking advantage in globalized markets.

Thus, engine cadets' current skill level is identified and compared to 21st-century skills, and a training program can be recommended to address weaknesses and align their skills with 21st-century work environment requirements.

Conceptual Framework

Modern marine engineers are needed. 21st-century abilities are required for education and jobs in the contemporary economy (Van Laar, Van Deursen, Van Dijk, & De Haan, 2020). Cadet skill levels vary. These variations affect future labor performance and must be handled cautiously. In this evolution, Maritime Education and Training (MET) must improve seafarers' practical capabilities under the STCW '95 treaty as revised. New training items like ECDIS, BRM, multifunctional VTS, and marine sector needs are among these requirements. MET's new requirement-meeting method The quality of a country's MET also affects its mariners' market competitiveness (Mindykowski, Charchalis, Przybyowski, & Weintrit, 2013).

The author utilized Figure 2's IPOO methodology to find the answers needed to match cadets' abilities with 21st-century competencies.

This study's input variables are the engine cadets' self-assessment results, the onboard training officers' feedback on whether they have 21st-century skills, and their identified weaknesses. The training curriculum was adjusted based on onboard input.

The respondents' replies, relevant literature, research, and policies were studied, analyzed, and interpreted to provide solutions. The study outcome is a training program proposal based on the purposefully chosen respondents' appraisal of the ship's engine cadets' competence. Thus, a training program should increase cadets' talents and match 21st-century professional competencies. The research concluded that engine cadets with 21st-century abilities must be trained before their first assignment aboard.

The goal is to produce a pipeline of highly educated, experienced, and motivated workers for the sector (Bostick, 2015). Global employers seek professionals with technical expertise, interpersonal skills, diverse leadership, diverse teamwork, and diverse management (Tasso Eira de Aquino, Robertson, Allen, & Whitney, 2017). This research helps the MHEI build a strong connection with onboard training providers to guarantee employability.

Statement of the Problem

The study determined the alignment of the current skills of engine cadets while undergoing shipboard training with the necessary 21st-century skills.

Specifically, the following questions were answered:

1. Based on the respondents' responses, what are the perceived current skills of engine cadets in terms of the following 21st century skills?
    1.1. digital literacy
    1.2. effective communication
    1.3. high productivity
    1.4. inventive thinking
2. Is there a significant difference in the perception of the engine cadets and on-board training officers in terms of the following variables?
    2.1. digital literacy
    2.2. effective communication
    2.3. high productivity
    2.4. inventive thinking
3. What are the weaknesses in the current level of engine cadets' skills?
4. What are the negating factors in acquiring 21st century skills as perceived by the engine cadets and onboard training officers?
5. What measures can be recommended to align the engine cadet's skill to the 21st century skill?

Scope and Delimitations

This research examined the current skills of the engine cadets in line with the necessary 21st-century skills while aboard TORM vessels. In this connection, the subject areas that were investigated were 21st-century skills such as digital-age literacy, effective communication, high productivity, and inventive thinking.

The respondents to the survey questionnaires were limited to engine cadets and engine onboard training officers on TORM vessels owned and operated by TORM Shipping A/S in Copenhagen, Denmark. The survey was given only to the aforementioned vessels, with the Filipino management-level engineers serving as onboard training officers and first-time Filipino engineering cadets only. Meanwhile, the interview was conducted at the local office of TORM Shipping Philippines Inc. with the training department and recruitment department. Moreover, to increase the number of crewing and training managers to interview, two (2) other local agencies in the Philippines were included, namely: ZEABORN Marine Services (Philippines) Corp. and Spectrum Marine and Ship Management Inc.

Methods

Research Design

This mixed-methods research employed concurrent triangulation. Triangulation increases research credibility and validity by combining ideas, techniques, or observers. A study's credibility and validity depend on how well it represents and analyzes the notions or concepts being studied (Noble & Heale, 2019). It involves using several data sources to study a phenomenon or research subject. Different perspectives may affirm, develop, or enlighten the study issue. This reduces personal and methodological biases and improves reproducibility (Abdalla, Oliveira, Azevedo, & Gonzalez, 2018).

This technique enabled the researcher to analyze engine cadets' 21st-century performance, such as digital literacy, effective communication, high productivity, and imaginative thinking, which may affect their training success. Thus, this study will help analyze engine cadet performance and build 21st-century talent.

Respondents to the Study

Cadets, aboard trainers, and business department executives responded.

Purposive sampling selected respondents. The first TORM cadets were aboard. They were picked for their new academic and job

experiences. 24 cadets. The research has 21 participants.

Filipino marine engineers oversee TORM vessel training officers. They were chosen because they teach and oversee engine cadets aboard. The survey included 27 of the 37 training officers.

The research included two TORM Shipping Philippines department heads. Under HR, they oversaw training and recruiting. Two more corporate representatives were studied. Spectrum Marine and Ship Management Inc. and ZEABORN Marine Services (Philippines) Corp.

The shore staff screened freshly recruited engine cadets from national institutions. Before departure, they have cadet skill levels.

Ethical Considerations

This study followed ethical guidelines. Before participating, respondents signed an informed consent form. Informed consent explained the study's goals. Republic Act 10173, the Data Privacy Act, demands permission and a good justification for data collection. The study was voluntary. The study participants were not in danger and received no incentives.

The researcher prioritized the anonymity, privacy, and secrecy of respondents and replies. Research data was kept secret and utilized exclusively for the research. The researcher kept respondent names confidential. Respondents are recognized by their study number.

Instrumentation

The research included a survey and an interview guide questionnaire.

The researcher-made survey was based on enGauge 21st-Century Skills: Digital Literacies for a Digital Age (Lemke, 2002). Since all responders agreed, two sets were transformed into Google surveys.

The initial survey questionnaire included three elements for training officers aboard. The questionnaire contains: (1) Part I profiles the aboard training officers who supervise cadets. (2) Part II examined the engine cadets' 21st-century competencies as assessed by the shipboard training officer and identified the most essential improvements. (3) Part III examined the onboard training officer's viewpoint and the engine cadets' 21st-century skill development barriers.

First-time engine cadets received three surveys in the second batch. Part I determined the profile of the participating engine cadets; Part II determined their current skills and weaknesses in accordance with 21st-century skills and determined the most needed improvement; and Part III determined the common negating factors that prevent them from acquiring 21st-century skills.

Finally, in-depth interviews and document inspections provided qualitative data. In-depth interviews let people be spontaneous, flexible, and sensitive while extracting valuable personal experiences and viewpoints. The researcher learned how to suggest a new maritime training program from the shipboard training and recruiting officers' personal experiences. The cadet responders provided additional remarks that helped the researcher understand the problems they had in attaining 21st-century abilities so that future training programs might assist and empower pupils to improve their talents.

Validation of the Instrument

Maritime training officials from several institutions assessed the interview guide and survey questionnaires. Three shipping general managers, consultant maritime officers, and plan maintenance managers from Techmarine Asia Shipmanagement, Inc., Adamson (Philippines) Inc., and ZEABORN Marine Services (Philippines) Corp. served as validators and reviewers.

The validators confirmed the instruments asked research problem-solving questions. Experts rated each questionnaire item to evaluate its validity. The panel's suggestions were implemented promptly.

Data Gathering Procedure

The Human Resources and Training Departments of TORM Shipping Philippines Inc. gave permission to perform the study to ensure ship owners and management accepted it.

Shore participants were contacted through email to set up an interview or obtain the questionnaire, while onboard participants were informed about the surveys by email.

Before recruiting research participants, permission was asked. Potential participants were emailed with research information and asked to participate.

The researcher sent the poll to training officers and engine cadets aboard. Google Forms hosted the survey.

Respondents who consented were contacted individually to schedule interviews. Zoom, Microsoft Teams, or in-person interviews were scheduled. The researcher recorded interviews. Each interviewee received the same questions before the meeting. The interviewer taped a 45-minute data-collection interview.

Data Analysis

Survey and interview data were evaluated individually. Descriptive statistics assessed the survey data. Statistical tools included: Weighted mean, frequency, and proportion. These tools addressed SOP 1 and SOP 2 and evaluated participants' replies, while the percentage shows respondents' relative frequency. The frequency distribution puts data into a comprehensible shape to develop a trend, making emerging data visible.

An independent-sample t-test answered SOP 3. It was used to discover gaps between engine cadets' existing abilities and 21st-century competencies. The equipment examined the means of two samples from the same population to detect changes.

The Shapiro-Wilk statistic verified the t-test's normality assumption. The Mann-Whitney U test was employed for non-normal data.

Excel calculated everything. All statistical tests had 0.05 significance. Tables summarize outcomes.

Interview Data

Thematic analysis explained the data. Thematic analysis arranges statements into themes that characterize the phenomena of interest using rigorous coding. It categorizes data and finds patterns. It interpreted data and addressed several themes (Boyatzis, 1998).

Results and Discussion

Profile of the Respondents

The study had two sets of respondents: the onboard training officers and the engine cadets. There was a total of 37 onboard training officers, but only 27 took part in the study. Ten (10) onboard training officers politely declined to participate in the study due to operational activities onboard such as internal and external audits, major overhauls of engine machinery, and company-related policies.

On the other hand, out of the 24 engine cadets, only 21 responded to the study. Presented here is their profile.

Onboard Training Officer Profile Rank. According to their rank, Chief Marine Engineer Officers make up the majority of respondents (56.6%), and 2nd Marine Engineer Officers come in second (44.4%), as shown in Table 3.

Table 3. Profile of Respondents according to Rank

RANK	f	%
Chief Marine Engine Officer	15	56.6
2nd Marine Engine Officer	12	44.4
TOTAL	27	100.0

Years in rank Table 4 shows that most respondents have 5 to 10 years of experience (37%). Furthermore, a significant percentage (33% of respondents) have 5 years or less of experience. The remaining respondents have experience of 11 to 15 years (14.8%), 16 to 20 years (11.1%), and 21 years or more (3.7%).

Table 4. Distribution of the Respondents according to Years of Experience

YEARS IN RANK	f	%
5 years or less	9	33.3
5 – 10 years	10	37.0
11 – 15 years	4	14.8
16 – 20 years	3	11.1
21 years and above	1	3.7
TOTAL	27	100.0

Engine Cadets Profile

Gender. Male respondents outnumbered female respondents (Table 5). In 2018, TORM Shipping Philippines hired female cadets while the cadet program was still in its early stages.

Table 5. Distribution of the Respondents According to Gender

GENDER	f	%
Male	19	90.5
Female	2	9.5
TOTAL	21	100.0

Respondents Perceived Current Skills of Engine Cadets relative to the 21st Century Skills

This part presents the results of the engine cadets' self-assessment on their current skills and the assessment of the onboard training officers on the engine cadets' skills. The standard skills utilized are the 21st century skills, which comprise the following sets of skills: digital literacy, effective communication, high productivity, and inventive thinking.

Digital Age Literacy

Table 6 shows the result of the assessment of skills in terms of digital age literacy. Both the self-assessment made by engine cadets and the assessment made by the onboard training officers show that engine cadets are competent in terms of digital literacy. This is evident by the overall mean for engine cadets at 3.09 and for onboard training officers at 2.52.

Table 6. Engine cadet's and Onboard training officers perceived current 21st Century Skills in terms of Digital Age Literacy

Digital Age Literacy	Cadets		Officers	
	Mean	IN	Mean	IN
a. Able to communicate, interact, and work with individuals from other cultural groups, using technology where appropriate.	3.24	Competent	2.63	Competent
b. Able to determine what is the fault and what is needed for problem solving shown in the Main and Auxiliary machineries 'parameters monitoring systems.	3.19	Competent	2.41	Less Competent
c. Able to demonstrate a sound conceptual understanding of the digital monitoring system parameters and view myself as proficient users of these systems.	3.14	Competent	2.85	Competent

Digital Age Literacy	Cadets		Officers	
	Mean	IN	Mean	IN
d. Able to understand digital representational, explanatory, abstract, and symbolic images shown in the Main and Auxiliary machineries 'parameters monitoring systems.	3.05	Competent	2.44	Less Competent
e. Have the knowledge and understanding of scientific concepts and processes required for digital monitoring system parameters.	2.81	Competent	2.26	Less Competent
Overall Mean	3.09	Competent	2.52	Competent

Engine Cadets. Looking closely at the different digital literacy skills, engine cadets perceived themselves to be competent in all five areas. Specifically, they are competent in communicating, interacting, and working with individuals from other cultural groups, using technology where appropriate (M = 3.24).

Furthermore, digital technology has become a necessity and a vital part of their lives. It has changed the way university students approach learning (Anthonysamy, L., 2020). According to the same literature cited, university students are accustomed to using their digital devices for nearly anything, including communication, cooperation, accessing different sources of information for answers, and so on.

On the other hand, engine cadets' competence, with the lowest weighted mean of 2.81, is in terms of their skill in understanding scientific concepts and processes required for digital monitoring system parameters.

Onboard Training Officers The on-board training officers perceived the engine cadets' digital literacy as competent in only two areas: being able to demonstrate a sound conceptual understanding of the digital monitoring system parameters and view myself as proficient users of these systems (2.85), and being able to communicate, interact, and work with individuals from other cultural groups using technology where appropriate (2.63).

However, the engine cadets were considered less competent in three areas: understanding digital representational, explanatory, abstract, and symbolic images shown in the main and auxiliary machineries' parameter monitoring systems (M = 2.44); determining what is the fault and what is needed for problem-solving shown in the main and auxiliary machineries' parameter monitoring systems (M = 2.41); and understanding scientific concepts and processes required for digital monitoring system parameters (M = 2.26).

The results signify that the engine cadets have the capability to operate and use digital technology onboard. The ability to operate software or a digital device is only one aspect of digital literacy that both respondents agree is competent. As a result, it includes the multiple sophisticated cognitive, physical, sociological, and emotional abilities required for people to function well in digital environments.

However, the areas where the engine cadets' skills were perceived as less competent by onboard training officers need to be enhanced.

The shipping business is becoming more technical, and it demands a highly skilled and specialized crew ready to embrace continuously evolving technology. The failures of complex automated systems cause fatalities and very high costs. Ensuring that the man-machine interface is fully achieved, and the crew is well trained on these states of systems is necessary (Demirel, 2020).

Effective Communication

Table 7 shows the result of the assessment of skills in terms of effective communication. Similar to the result on digital age literacy, both the self-assessment made by engine cadets and the assessment made by the onboard training officers show that engine cadets are competent in terms of effective communication.

As expected, engine cadets' perceptions of their skills were higher (3.39) than those of the onboard training officers (2.76). As mentioned earlier, engine cadets tend to overrate their competence. Engine cadets considered themselves highly competent in four areas and only competent in one area. On the other hand, onboard training officers rated engine cadets as competent in all five areas.

Table .7 Engine Cadet's and Onboard Training Officers Perceived Current 21st Century Skills in terms of Effective Communication

Effective Communication	Cadets		Officers	
	Mean	IN	Mean	IN
a. Able to listen well, seek mutual understanding, welcome full sharing of information, and consider others' views before commenting.	3.71	Highly Competent	3.00	Competent
b. Able to apply collaborate maintenance skills in a variety of situations. (Can explain himself clearly)	3.43	Highly Competent	2.81	Competent
c. Able to listen respectfully and objectively; offer constructive feedback in maintenance work planning.	3.29	High Competent	2.89	Competent
d. Can be responsible in the use of technology systems, information, and technology.	3.29	Highly Competent	2.52	Competent
e. Able to align my goals to the goals of others during collaborative maintenance work activities.	3.24	Competent	2.56	Competent
Overall Mean	3.39	Highly Competent	2.76	Competent

Engine Cadets. It can be seen in Table 7 that Engine Cadets perceived their skills as highest in listening well, seeking mutual understanding, welcoming full sharing of information, and considering others' views before commenting (M = 3.71). On the other hand, they perceived themselves as competent in aligning their goals with the goals of others during collaborative maintenance work activities (M = 3.24).

Onboard Training Officers Furthermore, onboard training officers' perceived engine cadets' skills in terms of all five indicators as competent, with a weighted mean ranging from 3.00 to 2.52. They rated engine cadets highest in listening well, seeking mutual understanding, welcoming full sharing of information, and considering others' views before commenting (M = 3.00). On the other hand, engine ratings were rated lowest in their skills in terms of being responsible in using the technology systems, information, and technology (M = 2.52).

The results from both respondents signify that the engine cadets have effective communication skills. Dacwag (2018) explained that Filipino seafarers had no trouble communicating with different people and various cultures. Moreover, the STCW Convention 1978 as amended, SOLAS, the ISM Code, and other international standards impose strict requirements on effective communication for the safety of crews and vessels. The majority of the people in the Philippines speak English at least somewhat fluently, making it one of the largest English-speaking countries in the world (Cabigon, 2015). Additionally, more than 14 million Filipinos speak English, which has traditionally been one of the nation's official languages (Cabigon, 2015).

While the results show that engine ratings are competent in terms of communication, areas with a low weighted means need to be enhanced and, therefore, should be given attention. The respondents from shipping companies cited the following explanations for the communication skills of engine cadets:

The results indicate that the ability to convey information through effective communication is seen as a vital ability in the 21st century. Good communication helps to forge strong professional and interpersonal bonds. The STCW, including the Manila Amendments (2011), mandates that seafarers be proficient in English, the maritime language, in both speech and writing. The tables of specifications for minimum standards do not, however, provide details on how to attain this competency. As the engine cadets advance in their careers, they must not only possess the fundamentals of communication but also exhibit professionalism in this area.

When the communication onboard the ship does not run well, there is a possibility of miscommunication. Ineffective or misunderstood communication may have serious results. Crews normally use their mother tongue on board ships while using the internal telephone system or doing face-to-face communication. As a result, communication difficulties may lead to accidents.

High Productivity

Table 8 shows the engine cadet respondents' and onboard training officers' perceptions of the level of skills of engine cadets in terms of high productivity. Similar to the engine skills on effective communication, both sets of respondents have the same perception that engine cadets are competent in terms of high productivity. Again, engine cadets overrated themselves as compared to the rating given by the onboard training officers.

Table 8. Engine Cadets' and Onboard Training Officers' Perceived Current 21st Century Skills in terms of High Productivity

Inventive Thinking	Cadets		Officers	
	Mean	IN	Mean	IN
a. The engine cadet can think about Main and Auxiliary machineries problems from multiple perspectives, understand they can be solved using different strategies and can involve more than one solution.	3.33	Highly Competent	2.44	Less Competent
b. The engine cadet can use what they have learned during maintenance work to adapt to new situations.	3.19	Competent	2.44	Less Competent
c. The engine cadet can make an active attempt to learn about and keep abreast of maintenance ideas and working principles of main and auxiliary machineries.	3.14	Competent	2.70	Competent
d. The engine cadet can exhibit curiosity, inquisitiveness, wonder, and excitement in maintenance work activities and planning	3.00	Competent	2.37	Less Competent
e. The engine cadet can look for and correct problems on Main and Auxiliary machineries as they occur; abandon strategies that prove to be ineffective	2.29	Competent	2.19	Less Competent
Overall Mean	3.11	Competent	2.43	Less Competent

Engine Cadets. It can be observed in Table 8 that engine cadets perceived themselves as highly competent (3.43) in their ability to enhance their skills in learning about the maintenance routine through both general technology tools and those specific to a field of study. While the four remaining indicators in this area were rated as competent (3.24 to 2.95). The lowest weighted mean was on the engine cadets' ability to ensure that procedures for maintenance

are accurate, carefully researched, and well documented (application of information literacy) (M = 2.95).

Onboard Training Officers Moreover, the onboard training officers' perceived engine cadets as competent in terms of their ability to enhance their skills in learning about the maintenance routine through both general technology tools and those specific to a field of study, to frame meaningful questions that provide clear direction to maintenance work planning processes (M = 2.70), and to ensure that maintenance procedures are accurate, carefully researched, and well documented (application of information literacy) (M = 2.63).

Interestingly, onboard training officers perceived engine cadets to be less competent when it comes to their ability to understand the value of tools for particular maintenance work and be comfortable using these tools (M = 2.41) and to skillfully integrate and apply technological, informational, and visual literacies to generate quality maintenance work results (M = 2.19). These are the areas that need to be enhanced. It is necessary to improve training in high productivity skills, such as the capacity to create relevant, high-quality work outputs (i.e., engine cadets skilled at developing intellectual, informational, or material products that serve genuine purposes and arise as a result of their using real-world tools to solve or communicate about real-world problems).

The interview participants from one of the shipping companies have this to say about the high productivity skills of engine cadets:

Overall, the results signify that the engine cadets have high productivity skills. Filipino seafarers have always been regarded as one of the most industrious workforces in the world as justified by the participants from different shipping companies:

Inventive Thinking

Inventive thinking abilities are one of the fundamental characteristics of the 21st century. This is to remain adaptable and deal with the chances and problems that come with the complicated and rapidly changing environment. Table 9 shows the result of the engine cadets' inventive thinking skills according to their self-assessment and the perception of the onboard training officers. The results show a big disparity between the self-perception of engine cadets and that of the assessors, the onboard training officers. Expectedly, the self-assessment of engine cadets on their inventive thinking skills is high (M = 3.11 or competent).

On the other hand, onboard training officers perceived engine cadets as less competent when it came to their inventive thinking skills (M = 2.43 or less competent). According to one interview participant, "Cadets nowadays are more focused on YouTube, which is not a formal reference; they should know how to select the proper references".

Table 9. Engine cadet's and Onboard training officers perceived current 21st Century Skills in terms of Inventive thinking

Inventive Thinking	Cadets		Officers	
	Mean	IN	Mean	IN
a. The engine cadet can think about Main and Auxiliary machineries problems from multiple perspectives, understand they can be solved using different strategies and can involve more than one solution.	3.33	Highly Competent	2.44	Less Competent
b. The engine cadet can use what they have learned during maintenance work to adapt to new situations.	3.19	Competent	2.44	Less Competent
c. The engine cadet can make an active attempt to learn about and keep abreast of maintenance ideas and working principles of main and auxiliary machineries.	3.14	Competent	2.70	Competent

Inventive Thinking	Cadets		Officers	
	Mean	IN	Mean	IN
d. The engine cadet can exhibit curiosity, inquisitiveness, wonder, and excitement in maintenance work activities and planning	3.00	Competent	2.37	Less Competent
e. The engine cadet can look for and correct problems on Main and Auxiliary machineries as they occur; abandon strategies that prove to be ineffective	2.29	Competent	2.19	Less Competent
Overall Mean	3.11	Competent	2.43	Less Competent

Respondents from shipping companies who directly handle cadets and monitor their performance after disembarkation, provided some insights on the engine cadets' inventive thinking skills:

The results show that engine cadets are less competent in most skills under inventing thinking, which means that interventions are needed in order for engine cadets to successfully compete in the 21st century workplace.

As a result, also, many students today are observed to be lacking in the ability to think inventively and this could prove to be problematic for the world's future. Studies indicate that a great number of existing professions will be gone in a short while and will make way for jobs combining creative, innovative, and change processes. This state of affairs should bring about an economy of creativity with obvious social consequences on the labor market. The employee of the future will have to associate "creativity" with "social intelligence" and "manipulation" (Claeys, 2020).

The summary of the engine cadets' 21st century skills according to the perception of both engine cadets and onboard training officers is shown in Table 10.

Table 10. Summary of the Engine Cadets' 21st Century Skills as Perceived by the Respondents

21st Century Skills	Cadets		Officers	
	Mean	IN	Mean	IN
Digital age literacy	3.09	Competent	2.52	Competent
Effective communication	3.39	Highly Competent	2.76	Competent
High productivity	3.16	Competent	2.53	Competent
Inventive thinking	3.11	Competent	2.43	Less Competent
Overall Mean	3.19	Competent	2.56	Competent

Both engine cadets and onboard training officers perceive engine cadets to have competence in the 21st century skills as evidenced by the overall mean of 3.19 and 2.56, respectively. Engine cadets are highly competent in terms of effective communication according to their self-assessment while they are competent in digital age literacy, high productivity and inventive thinking.

On the other hand, onboard training officers consider engine cadets competent in digital age literacy, effective communication, and high productivity.

The trend of the results show that the assessment made by the onboard training officers are feedback on the performance of engine cadets. It is regarded necessary to obtain immediate feedback from ship officers incharge of the shipboard training of cadets in order that appropriate action is taken. In the context of the study, the onboard training officers' feedback can be made as basis for the recommendation of an intervention training program to enhance the engine cadets' capabilities on the three (3) skills of inventive thinking, high productivity and digital age literacy.

The Bachelor of Science in Marine Engineering (BSMar-E) program must include supplemental training in relation to the 21st skill as a requirement in order to fulfill Regulation III/1 of the Standards of Training, Certification and Watch Keeping (STCW) Convention, which outlines the necessary seagoing service.

Significant Difference in the Perception of the Engine Cadets and Onboard

Training Officers

Table 11 shows the computed p-value for the perceptions of engine cadets and onboard training officers. Since the computed p-values are less than the level of significance of 0.05, it means that there is a significant difference in the perception of the engine cadets and onboard training officers of the 21st century skills of engine cadets. The onboard training officers' mean ratings are significantly lower than the engine cadets as seen in Table 11. This holds true for all four of the 21st-century skills.

Table 11. Engine cadet's current 21st Century Skills as perceived by the cadets and the officers

21st Century Skills	Cadets		Officers		p value
	Mean	IN	Mean	IN	
Digital age literacy	3.09	Competent	2.52	Competent	<0.001
Effective communication	3.39	Highly Competent	2.76	Competent	<0.001
High productivity	3.16	Competent	2.53	Competent	<0.001
Inventive thinking	3.11	Competent	2.43	Less Competent	<0.001
Overall Mean	3.19	Competent	2.56	Competent	<0.001

Weaknesses in the Current Level of Skills of Engine Cadets

The study determined the weaknesses of the first-time engine cadets in relation to their 21st century skills during shipboard training in order to assist them on areas that need interventions. These are areas where onboard training officers consider engine cadets to be less competent, as follows:

Main and Auxiliary Machineries' Parameters Monitoring Systems

Under the digital age literacy, engine cadets according to onboard training officers are weak in terms of *determining the fault and solving problem displayed in the main and auxiliary machineries' parameters monitoring systems*. In addition, they are also weak in *understanding digital presentational, explanatory, abstract, and symbolic images shown in the Main and Auxiliary machineries 'parameters monitoring systems*.

The results suggest that engine cadets need to have more exposure to the main and auxiliary machineries' parameters monitoring systems to familiarize themselves with its components, concepts, and processes in order to have better understanding on its uses.

Familiariization Onboard Equipment and Machinery

In terms of high productivity, engine ratings were found lacking in skills on their *ability to understand the value of tools for a particular maintenance work and are comfortable using these tools;* and *the ability to skillfully integrate and apply technological, information, and visual literacies to generate quality maintenance work result*.

Technology Adaptability

The identified weaknesses of engine cadets in terms of their inventive thinking skills are in the following areas: 1) *can think about Main and Auxiliary machineries' problems from multiple perspectives, understand they can be solved using different strategies and can involve more than one solution;* 2) *can use what they have learned during maintenance work to adapt to new situations; can exhibit curiosity, inquisitiveness, wonder, and excitement in maintenance work activities and planning;* and 3) *can look for*

and correct problems on Main and Auxiliary machineries as they occur; abandon strategies that prove to be ineffective. This claim was further supported by one of the participants from the shipping company under the training department:

Negating Factors in Acquiring the 21st Century Skills as Perceived by the Engine Cadets and Onboard Training Officers

This section delves into the perceptions of engine cadets and onboard training officers on the negative factors in acquiring 21st century skills. The majority of the factors in Table 12 were taken from Ochavillo's (2020) study "A Paradigm Shift of Learning in Maritime Education amidst COVID-19 Pandemic". The data were collected through the survey questionnaire of the engine cadets and interview of shipping company representatives.

Engine Cadets

Table 12 shows the engine cadets perceived negating factors in acquiring 21st-century skills. Engine cadets were not able to take full advantage of e-learning that was being used at present because of their inadequate access to technology in school (52.38) and their lack of access to technology in their homes (33.33). If this is the case, then cadets are not able to acquire the digital literacy skills they need since they are not equipped with the tools to do so.

Information and communications technologies (ICT) - devices such as cellular phones, tablets, computers, and their related applications and software— have long been cited as a key resource to better prepare young people to participate in a global knowledge economy.

The *ship's organizational structure* likewise contributes to engine cadets not being able to acquire the necessary skills. Specifically, it is difficult to consult or ask questions when senior officers onboard are not approachable or strict. Senior officers should be there to guide the cadets, and to mentor them. However, the organizational structure onboard affects the cadets' learning and thus, consequently affecting acquisition of skills.

Another negative factor is the teachers' lack *of commitment in implementing the 21st century skills*. This can be rooted to the *inadequate tools needed for teaching 21st century skills*, *the lack of understanding on the value of the 21st century skills*, *insufficient curriculum content*, and the *lack of development support provided to them by the school*. These are school-related factors that need to be addressed to equip engine cadets with 21st century skills.

Table 12. Negating Factors in acquiring 21st Century Skills as perceived by the perceived by the engine cadets

Challenges and Factors	n	%
1. Limited access to technology (use of School equipment)	11	52.38
2. Lack access to technology at home (Parental support)	7	33.33
3. Ships organizational structure (Hard to approach and strict Senior engineer)	7	33.33
4. Teacher lacks commitment in implementing the 21st century skill	7	33.33
5. Inadequate tools needed for teaching the 21st century skill	5	23.81
6. Lack of understanding regarding the value of acquiring the 21st century skill.;	5	23.81
7. Insufficient curriculum content to teach required 21st century skills	4	19.05
8. School lacks development support for teachers' skill to implement 21st century skills	4	19.05
9. Lack of interest in socialization	3	14.29
10. Company policies and procedures onboard ships.	2	9.52
11. Lack of interest in learning the required 21st century skills	2	9.52

Engine cadets' knowledge can be enhanced with the proper development support from maritime higher education institutions Alternatively, the interview participants from shipping companies suggested that interfaces may be used to advance seafarers' training in order to benefit the maritime industry's technological advancement.

Onboard Training Officers

Table 13 shows the onboard training officers perceived negating factors in acquiring 21st-century skills. The results show that onboard training officers consider both school- and cadets-related factors as affecting acquisition of the 21st century skills.

Most of the onboard training officers consider the *school's lack of development support for teacher's skills to implement the 21st century skills* as the number one factor that negates engine cadets' acquisition of the skills. They consider that learning should start from school. Teachers are a very important resource for the learning of students; hence, support should be provided to them. They are the most important people in the curriculum implementation. With their knowledge, experiences, and competencies, teachers are central to any curriculum development effort. Better teachers support better learning because they are most knowledgeable about the practice of teaching and are responsible for introducing the curriculum in the classroom.

Similar to the engine cadets, onboard training officers also consider the *limited access to technology* as contributory in non-acquisition of skills. Furthermore, other school-related factors mostly considered negating skills acquisition are *insufficient curriculum content to teach the required 21st century skills,* and *inadequate tools needed for teaching the skills.*

On the other hand, engine cadets-related factors include *lack of understanding of the value of acquiring the 21st century skills*, and *lack of interest in learning the required 21st century skills*.

Overall, the findings suggest that factors contributing to non-acquisition of 21st century skills are mostly school-related factors. These are supposed to be provided to the teachers for them to teach the 21st century skills and for students to acquire the needed skills. The results also demonstrate that MHEIs were not equally providing their students with marine engineering training for marine engineers, regardless of their standing and capacity to provide the necessary logistics. This confirms the barriers to learning 21st century skills, which the Engine Cadets and Onboard Training Officers observed.

These factors need to be addressed properly to enhance the engine cadet's extent of competency regarding 21st Century Skills by enhancing the curriculum content ensuring that lessons covered the skills to be achieved by the engine cadets.

These tools can be incorporated into the standard academic curricula with a focus on teaching 21st-century skills. These can help in modifying students' habits and assuring their success in their employment and personal life.

The conduct of enhancement training for teachers are also important. As a complement to the 21st-century skills curriculum, MHEIs should also implement programs such as professional development workshops to provide their teachers with a platform where they could share their ideas and opinions in as much as they are an integral part of the environment that affects the curriculum. Professional development workshops could build appropriate information and abilities that assist them to effectively contribute to curriculum development operations.

Creating system standards and support can improve the learning environment and school climate. In the context of this research, it is clear that there is lack of leadership support for following rules and regulations, educating teachers, giving them the tools and materials, they need. It is with good practice that teachers will be inspired and students to give it their utmost in order to successfully achieve the program's intended results.

The onboard training officer's responses to the survey were based on their own experiences with having engine cadets aboard their ships. As learning managers, on-board training officers can use a variety of approaches to help cadets develop their 21st-century abilities.

Table 13. Negating Factors in Acquiring 21st Century Skills as Perceived by the Onboard Training Officers

Challenges and Factors	n	%
1. School lacks development support for teacher's skill to implement 21st century skills.	16	59.26
2. The engine cadets' limited access to technology (use of School equipment);	16	59.26
3. Insufficient curriculum content to teach required 21st century skills	15	55.56
4. Inadequate tools needed for teaching the 21st century skill	13	48.15
5. Teacher lacks commitment in implementing the 21st century skill;	13	48.15
6. The engine cadets lack the understanding of the value of acquiring the 21st century skill.	12	44.44
7. The engine cadets' lack of interest in learning the required 21st century skills	12	44.44
8. Teachers lacks the understanding of the required 21st century skills;	10	37.04
9. The engine cadets lack access to technology at home (Parental support);	9	33.33
10. Ship's organizational structure (Hard to approach and strict Senior engineer)	8	29.63
11. Company policies and procedures onboard ships.	6	22.22

While Table 12 focused on the difficulties and barriers faced by the engine cadets in obtaining 21st-century skills, this study also outlined the difficulties and barriers to acquiring these skills as seen by the onboard training officers in Table 13. This reveals that the common factor in acquiring the required 21st-century skill was engine cadets' limited access to technology (use of School equipment) which needs to be addressed.

Findings

Engine cadets were mostly men, with a few women. The Chief Marine Engineer Officer and Second Marine Engineer Officer aboard training officers have five to ten years of management-level experience.

During onboard ship training, engine cadets and onboard training officers assessed their abilities and preparedness for their new job and the maritime business. Engine cadets considered themselves excellent communicators. They are digitally literate, productive, and creative. On the other hand, aboard training, commanders thought engine cadets were proficient in computer literacy, communication, and productivity. Engine cadets were less imaginative.

The research also indicated that engine cadets and aboard training officers had quite different views of 21st-century competencies. All four 21st-century talents apply.

Engine cadets list the following as negating factors in acquiring the skills: limited access to technology (use of school equipment), lack of technology at home, ship's organizational structure, teacher's lack of commitment to implementing 21st century skills, inadequate tools for teaching the skills, lack of understanding about the value of acquiring the skills, and insufficient curriculum content to teach the required skills. Onboard training officers noted certain deterrents: The engine cadets' restricted access to technology (school equipment) and insufficient curriculum material to teach 21st century skills; the school's lack of development assistance for instructors to adopt 21st century skills; Insufficient tools for teaching 21st-century skills; the teacher's lack of commitment to implementing the skill; the engine cadets' lack of understanding of the value of acquiring the skill; their lack of interest in learning the skill; and the teacher's lack of understanding of the skill

Both engine cadets and aboard training commanders saw flaws in the findings. Under digital age literacy, their weaknesses are determining faults and solving problems in the main and auxiliary machines' parameter monitoring systems and understanding the digital

presentational, explanatory, abstract, and symbolic images.

In terms of high productivity, engine ratings were found lacking in skills such as understanding the value of tools for a particular maintenance work and being comfortable using them, and skillfully integrating and applying technological, informational, and visual literacies to produce quality maintenance work results.

Engine cadet creative thinking flaws include: 1) can think about Main and Auxiliary Machineries' problems from multiple perspectives, understand they can be solved using different strategies, and can involve more than one solution; 2) can use what they have learned during maintenance work to adapt to new situations; can exhibit curiosity, inquisitiveness, wonder, and excitement in maintenance work activities and planning; and 3) can look for and fix problems as they occur; abandon

Conclusion

Engine apprentices are partially 21st-century. Engine apprentices excel in communication, computer literacy, productivity, and creativity. To adapt to the 21st century, people must keep improving their talents. The transport business requires highly skilled and adaptable workers. Complex automated system failures cost lives and millions. Thus, staff must be trained on these systems. Engine cadets must improve their high productivity skills, such as the ability to produce relevant, high-quality work outputs, to develop intellectual, informational, or material products that serve real purposes and result from their use of real-world tools to solve or communicate about real-world problems. MHEIs must prepare graduates for worldwide competitiveness and success in the 21st century workplace and society.

The null hypothesis that engine cadets and onboard training officers see engine cadets' 21st-century talents similarly is rejected. Onboard training officers score far worse than engine recruits in all four 21st-century competencies.

Engine and onboard training officers' complaints represent maritime higher education institutions' responsibility to teachers and students. The data also show that MHEIs did not teach marine engineers equitably, regardless of their status and ability to offer logistics. Standards and system support improve learning and the school atmosphere. Leadership support for following rules, training teachers, and equipping them is lacking. Effective practice will drive teachers and students to work hard to attain program goals.

Faculty must have 21st-century abilities, specifically. This requires professional development for faculty. The curriculum should promote 21st-century skills. The faculty needs new recruits to have access to computers and the internet to teach.

Motor trainees' weaknesses were identified. Digital literacy, high productivity, and innovative thinking are involved. Innovative thinking includes complex internal processes. Thus, problem-solving abilities are needed to handle complicated, unexpected, and unanticipated events. Students must solve online tasks to create or solve difficulties. Interventions are needed to modernize engines. MHEIs must consistently innovate their curriculum and seek areas where students may grow. Benchmarking, feedback, and evaluation data may help.

Recommendations

Students and professors get assistance. Students need computers and the Internet. This will allay engine recruits' fears about technology access owing to their dependence on educational equipment. To teach 21st-century skills, educators need technology, the internet, and other tools.

Enhance the curriculum to teach 21st-century skills. Diverse TLAs help teach 21st-century skills. These may help students change their behavior and succeed in life. MHEIs should teach 21st-century skills.

MHEIs should create programs or send professors to professional development training on 21st-century skills and their classroom use. Teachers must understand and use 21st-century skills. This will help MHEIs retain 21st-century talent.

For a more complete 21st century skills study, the number of respondents must be increased. This study used a limited sample of TORM cadetship recruits and aboard training

officers. The lack of study on recruits' 21st-century abilities and worldwide career preparedness makes future empirical investigations viable.

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