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ENGINE-ROOM SIMULATOR (ERS) AS ASSESSMENT TOOL IN HIGHER EDUCATION: CASE STUDY OF A MARITIME EDUCATION & TRAINING INSTITUTION IN MALAYSIA

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ABSTRACT

This research investigates the underutilisation of Engine-Room Simulator (ERS) as an assessment tool for marine engineers in Malaysia. The study focuses on a Malaysian Maritime Education and Training Institute (METI) offering a Diploma in Marine Engineering and aims to explore educators' perspectives on the usage of ERS, how ERS is incorporated into METI programmes, challenges to its implementation, and sustainability plans. The research methodology involves semi-structured interviews with relevant key persons from a METI. The study intends to offer more insights into ERS implementation's current practices and sustainability plans in METIs, benefiting maritime educators and increasing seafarers' proficiency and competency.

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1.0 INTRODUCTION

Incorporating simulators into the curriculums of Maritime Education and Training (MET) institutions has been standard practice for the past few decades. Initially, simulator-based training was implemented to develop navigational skills such as passage planning and coordination between the master and harbour pilot. This was the original goal of the programme. Today, simulators may be used in various applications within the maritime industry. These applications include training for transferring operations, navigation operations, cargo handling, engine control, and anchor handling (Hanzu-Pazara et al., 2008). The term " simulator " is a depiction of a real scenario generated by the by-products of mechanical, electromechanical, or computer systems is what is meant by the term "simulator." The expensive cost of the original equipment and the difficulties in gaining access to the actual piece of machinery to carry out the necessary training or research in a secure environment are the primary factors that contribute to the utilisation of the Engine-Room Simulator (ERS) in MET (Stetsenko & Stetsenko, 2019). Several types of training cannot be repeated in the real world for reasons relating to safety. The usage of marine simulators as training and examination instruments are mandated by the international convention of Standard of Training, Watchkeeping, and Certification (STCW) (Fisher & Muirhead, 2019).

Despite the numerous advantages of using ERS as an assessment tool for marine engineers, Malaysia still has not fully utilised this technology. Although ERS can provide a realistic and cost-effective method for assessing the abilities and knowledge of marine engineers in a secure environment, Malaysia Marine Department (MARDEP) still obligate the primitive approaches, namely, written tests and oral examination, as tools for evaluating the competency of marine engineers (Malaysia Marine Department, 2021), prior issuing the Certificate of Competency (COC) as a marine engineer. This underutilisation of ERS in Malaysia may have resulted in lost chances to enhance digital skills and improve the competency and proficiency of marine engineers.

2.0 LITERATURE REVIEW

Marine engineers are highly qualified experts who play a crucial role in the maritime industry. They serve as watchkeepers who maintain the engines, boilers, and other technical systems aboard ships and other marine vessels (Laskowski et al., 2015a). Marine engineers are essential to ships' safe and effective functioning, and they play a crucial role in assuring the safety of passengers, crew, and cargo. Marine engineers are vital to the worldwide shipping sector due to their technical expertise and knowledge of safe maritime operations, including environmental protection from ship pollution (Laskowski et al., 2015a).

The International Maritime Organization (IMO) is a United Nations specialised body regulating maritime affairs and promoting maritime safety and environmental preservation. The IMO has defined requirements and standards for the education, certification, and evaluation of marine engineers (International Maritime Organization, n.d.). These criteria are outlined in the International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) and its corresponding rules and guidelines.

To become a globally certified marine engineer, a person must satisfy the STCW's education, training, and examination criteria. Typically, this entails completing a recognised marine engineering degree, earning seagoing experience on a ship, and passing academic and practical exams (International Maritime Organization, 2017b).

The IMO also establishes minimum medical requirements for seafarers, including marine engineers. These requirements are intended to guarantee that marine engineers are physically and psychologically fit to perform their tasks safely and efficiently (Jensen et al., 2022).

The IMO collaborates closely with maritime organisations, governments, and industry partners to ensure that the standards for marine engineers are properly implemented and that seafarers obtain the training and certification necessary to operate in a safe and efficient manner.

By creating and enforcing international standards for marine engineers, the IMO plays a crucial role in safeguarding the environment and ensuring the safety and efficiency of global maritime operations (Mukherjee & Brownrigg, 2013).

Maritime Education and Training Institutions (METIs) are crucial in educating students about careers in the marine industry. They provide various programmes and courses to equip students with the information and skills required to work aboard ships, in ports, and other maritime-related industries (Milić-Beran et al., 2021). METIs give students the opportunities necessary to pursue successful careers in the marine industry, from basic safety training to advanced technical studies.

Malaysia Marine Department (MARDEP) acts as a maritime administrator under the umbrella of the Ministry of Transportation (MOT), in charge of monitoring seafarer certification and training, which includes ensuring that METIs meet accreditation criteria and that their training programmes are effective and comprehensive. This could include inspecting and auditing METIs, examining curricula and training materials, and monitoring the performance of their instructors and students.

MARDEP is also involved in the development and implementation of policies and regulations pertaining to seafarer training and certification, which may include establishing standards for the knowledge, skills, and competencies that seafarers must possess to work on board ships. MARDEP may also work with other maritime administrations and industry stakeholders to exchange best practices and improve the overall quality of seafarer training and certification programmes around the world.

Overall, the MARDEP's role in ensuring seafarers' competency through METIs is to ensure that seafarers are properly trained and certified to perform their duties safely and effectively and encourage seafarers' ongoing professional development throughout their careers.

Evaluating marine engineers' knowledge and abilities is crucially dependent on assessment. It helps to determine the level of competence and professionalism of maritime industry employees. Written examinations, practical assessments, and on-the-job assessments are among the ways to evaluate marine engineers' skills (Zincir et al., 2017). These assessments play a vital role in ensuring that marine engineers can perform their jobs safely and effectively and possess the knowledge and skills required to meet the demands of their profession.

The Engine-Room Simulator (ERS) is a highly advanced assessment instrument that plays a growing role in assessing marine engineers. The ERS provides a realistic, simulated environment where marine engineers can demonstrate their knowledge, skills, and talents in a safe and controlled setting (Zaini, 2020).

ERS is designed to simulate the conditions and systems in a ship's engine room, including the main engines, boilers, pumps, and other vital systems. It allows maritime engineers to practise and demonstrate their skills in various conditions, ranging from everyday operations to emergencies (International Maritime Organization, 2017a)

ERS offers various advantages over traditional assessment methods and provides a secure and controlled environment for testing. ERS can provide instant feedback on the work of maritime engineers, enabling them to discover areas for development and get specialised training. ERS also provides a consistent and standardised evaluation tool, which ensures that marine engineers obtain objective and fair evaluations of their talents (Cicek, 2017)

3.0 METHODOLOGY

The data gathering was carried out using a qualitative method. Since this study aims to investigate the current status of METI concerning using ERS as an assessment tool, the qualitative method is the most efficient approach to accomplish the goal.

3.1 Interview method

Because the interview provides clarity and enables respondents to respond to open-ended questions in greater depth, it was selected as the data collection method because of its versatility (Brace, 2013). This resulted from the respondents' considerable involvement in the marine business and their comprehensive understanding of the industry. Interviews are the method of choice when answering the questions posed in the research. However, a substantial amount of reliance is placed on the information provided by the respondents (Ghauri & Grønhaug, 2005). This is true regardless of whether or not the respondents are biased. Semi-structured interviews were favoured over other types because they enabled information to be compared among respondents and provided greater flexibility. This made it possible to obtain more useful information (Dawson, 2006).

3.2 Interview Protocol

Introduction: The researcher took a moment to introduce himself and his theory before the interview got underway. The researcher gave the participants an explanation of why their participation was necessary for the researcher to gather the required information, what would happen with the information obtained, and how the community would benefit from the knowledge.

Key questions: The data-gathering process was carried out through a method known as semi-structured interviews. The following are some general rules for interview questions, followed by more in-depth questions that probe further.

1. What is your perspective on using ERS as an assessment tool for METI?
2. How is ERS incorporated into your training programmes?
3. What are the challenges to implementing the usage of ERS as an assessment tool in METI?
4. How do we sustain the implementation of ERS as an assessment tool for METI?

Probing questions: By asking participants more in-depth questions regarding the significance of their comments, researchers persuaded participants to think more carefully about the significance of their comments. These questions were beneficial because they encouraged participants to contemplate the root or foundation of the problem the researcher was looking into.

Closing questions: Before the final questions were asked, the key informants were given the opportunity to make any final comments or provide any further information. During the closure, it was also requested of the key informants whether they had any ideas or solutions to offer concerning the issue.

Summary: The researcher gave a concise explanation of the primary topics addressed during the interview and checked with the subjects to ensure he had covered all pertinent information. The final inquiry that the researcher posed to the participants was whether there was anything else they would like to discuss with the researcher. In closing, the researcher conveyed their appreciation for their participation and time.

Every single one of the interviews was captured on an audio recorder. Due to the limited time available during the interview sessions, the researcher was required to follow up on a few topics via email and the Whatsapp mobile app. The transcriptions were independently checked with each participant to ensure the data's accuracy.

3.2.1 Ethical consideration

This qualitative study aims to conduct in-depth and adaptable research on a topic. This method was employed to gain a deeper understanding of METI’s educators’ viewpoints and METI on the utilisation of ERS as an assessment tool. Due to ethical considerations, the HEI's upper management has authorised permission to use data and research samples under the following conditions: if part or all of the study findings are to be published, the final copy of the research report must be presented to management, and prior approval must be obtained. After obtaining ethical approval for the study from the institution and higher authorities, educators in the METI were chosen on purpose to participate in this research. Participants signed a permission form and were advised that they might withdraw at any time. Only data from participants who consented to participate were included.

3.2.2 Profile of the key informants

Data were gathered using specially constructed study interviews based on the predetermined research topics. For this experiment, individuals were chosen using a carefully chosen sample strategy. The participants were selected from various positions and duties at METI in Malaysia. Participation was entirely voluntary, and there was no inducement offered. The information was taken between February 13 and February 20, 2023. Before the interviews, each participant signed a consent form.

Criteria	P1	P2	P3	P4
Gender	Male	Male	Male	Male
Age	41	36	41	50
Shipboard experience	5 years	12 years	5 years	9 years
Educations	Master in Mechanical Engineering, Degree in Electrical Engineering	Master in Mechanical Engineering (ongoing), Diploma in Marine Engineering	Master in Mechanical Engineering (ongoing), Degree in Electrical Engineering	Diploma in Marine Engineering
***COC type**	Electrotechnical Officer	Second Engineer Officer	Electrotechnical Officer	Chief Engineer Officer
Position	Senior lecturer	Lecturer	Lecturer	Senior lecturer
Teaching experience	13 years	4 years	5 years	19 years
****SME**	Marine electrical engineering	Marine engineering	Marine electrical engineering	Marine engineering
ERS involvement	Electrical related courses/training	Nil	Electrical-related courses/training	Nil
Interview duration	44 minutes	25 minutes	35 minutes	30 minutes

***COC: Certificate of Competency**

****SME: Subject Matter Expert**

Table 1**:** Profile of the key informants

Two senior lecturers with more than ten (10) years of teaching experience and two junior lecturers with lesser teaching experience were selected as participants. All of them are former seafarers and involve in teaching for the COC program. Under the faculty of marine engineering (FAME), two fields were involved in the interviews: marine mechanical engineering and electrotechnical engineering.

The goal of interviewing people from varied backgrounds is to obtain thoughts and viewpoints from a wide range of people to generate a more thorough and nuanced understanding of the topic under research. By interviewing people from various backgrounds, the researcher may learn about how different people or groups experience or perceive a similar issue and how this varies across cultural, social, and demographic lines.

This method is beneficial when investigating complex or controversial topics since it allows us to gain a more nuanced knowledge of the various viewpoints and experiences within a specific group or community. It can also help to guarantee that our research includes a diverse variety of voices and that our findings apply to a diverse range of stakeholders.

Generally, the goal of interviewing people from varied backgrounds is to get a more comprehensive and inclusive understanding of the topic under research and to create insights and suggestions relevant and applicable to a wide range of people and organisations.

3.3 Secondary data

During this research, the researcher additionally employed secondary data from the respective METI concerning the courses that use ERS as a learning and assessment tool to compare and analyse with all other data, such as;

1. Course specifications.
2. Evaluations forms.
3. Trainer’s log.
4. Assessment reports

3.4 Data Analysis and Presentation

All interview-related material, including video recordings, emails, and WhatsApp mobile app text messages, were professionally organised into files and folders. The subsequent phase includes numerous reading and listening sessions with simultaneous note-taking. Combining multiple codes is allowed for the selection of the most relevant ones and the creation of categories. The codes were categorised, and their connections were examined. Subsequently, the results were presented in a narrative format. Both deductive and inductive coding techniques were utilised in this method. However, because the researcher conducted an exploratory study and had to collect data from scratch, the inductive method was given greater weight (Christians & Carey, 1989).

In social science research, triangulation, a strategy that employs many case studies, is widely applied. This method is recommended since it enhances validity (Campbell & Fiske, 1959), makes sense of the data, and classifies it into the appropriate categories (Creswell, 2013). All primary and secondary data are compared for triangulation

4.0 FINDINGS

This chapter is organised to provide a comprehensive summary of the research findings. It begins with a summary of the collected data. The principal findings are then presented as themes, patterns, and insights derived from the data. Each theme is examined in depth, with supporting evidence to illustrate the findings.

4.1 Educator perspectives

Key question	Answers from participants
What are educators' perspectives on using ERS as an assessment tool for METI?	**Advantages of using ERS** • ERS gives the reflection of reality onboard the ship. (P2, P4) • The automated assessment produces marks faster (P2) • Ease the workload of the assessors. (P1, P3, P4) • The approach is in-line with IR4.0. (P4) • Benchmarking the aviation industry (P4) • The trainers can learn from ERS. (P1) • To meet industrial demand. (P4) **Complement vs replacement** • To complement the existing assessments. (P1, P2, P3) • ERS assessment helps to bridge the gap of the current assessment approach. (P1, P3) • Possible to be a total replacement of the existing assessment. (P4) **Focus areas to be assessed** • Suitable for evaluating critical and analytical thinking. (P1, P4) • Suitable for evaluating technical skills and procedural knowledge. (P1, P3) • Variety applications at all levels. (P1) • Fair assessment tool for know-how candidates but also poor communicators (P1, P3)

Table 2: *Summary of information related to the RQ1*

From the interviews, all the participants gave positive perspectives concerning using ERS as an assessment tool. P4 highlighted that the aviation industry has been using this approach since before, and the method is proven effective. ERS-based assessment is also perceived as in line with the education of IR 4.0, which aims to produce a generation with excellent critical and analytical thinking skills. As a result, the future generation may have the skills that are highly demanded in the modern workforce, which will be highly automated.

Even though P2 and P4 have never used them as teaching or assessment tools, both of them have experienced attending several ERS-based training. The majority of participants agreed that ERS-based assessment is to complement the flaws in the existing assessment approaches. However, P4 believes that ERS can replace the existing assessment methods with the correct approach.

P3 believes only certain aspects can be assessed in the ERS, such as technical skills, procedural knowledge and troubleshooting. It helps poor communicator candidates who understand and know how to perform tasks but have limitations in explaining things through writing or oral conversation. P1 and P3 agreed that candidates with good language ability could perform better in written and oral assessments.

According to P3, the workload of the assessor can be reduced as automated assessment from ERS can generate immediate results with reports. The assessment will become more objective, and this method can assess specific knowledge.

Although the study focuses on the COC programme of undergraduates, P1 explained that ERS-based assessment could be further expanded to the postgraduate level, which involves more managerial skills rather than technical skills.

4.2 Incorporation of ERS

Key question	Answers from participants
How is ERS incorporated into METI programmes?	**Positive** • ERS is used as an assessment tool in the High-Voltage course. (P1, P2) • ERS is occasionally utilised as a learning tool (P1, P3) • ERS is utilised for short courses, which are handled by another department. (P2 **Negative** • It's not part of the training or assessment tool for the COC programme (P1, P2, P3, P4) • MARDEP doesn't obligate the usage of ERS for the COC programme (P1, P2 & P4) • The number of ERS workstations is limited. (P1) • Less initiative from other lecturers. (P1) • ERS does not apply to all engineering topics. (P2, P4)

Table 3: Summary of information related to the RQ2

From the data collection, only P1 and P3 use ERS as teaching and assessment tool. Both of them incorporate ERS in a short course of marine electrical High-Voltage. In this short course, the hybrid ERS is used, which consists of a combination of a simulator and a physical Vacuum Circuit Breaker (VCB) real equipment. However, the training is not specifically for the COC program but for active seafarers who intend to sail onboard high-voltage vessels. MARDEP strictly regulates this high-voltage course.

However, P1 also takes the initiative to incorporate the ERS in his COC program. According to P1, he only brings the undergrad students, also known as cadets, if the ERS is available. The ERS is managed by another department which specialises in short courses.

All participants agreed that no requirement by the authority body causes very low utilisation of the ERS in the COC programme. P2 and P4 also mentioned that ERS is more on application than engineering fundamentals. Therefore, ERS is perceived as not relevant to all engineering topics. P1 also emphasised that multiple factors, such as the high workload of the lecturers, may cause low utilisation. The lecturers must be well-trained and spend hours to be familiarised with the ERS system. A limited number of ERS is another factor, as it requires good planning and management to enable all students to have the opportunity to use them.

From other secondary data, the researcher found that ERS is mainly utilised for short courses, which are mostly non-obligatory for the COC programme. Some shipping companies require an ERS-based assessment to promote marine engineers in the industry. The ERS is also used as a platform to assess the non-technical skills in resource management courses, and the training is regulated by MARDEP. The average rating for the course evaluation is 4.8 out of 5.0.

4.3 Challenges of Implementation

According to P4, the simulator manufacturer only provides the training package if the METI purchases the equipment, and further training will require additional costs. Therefore, the practice in the METI is only one-time training; the rest will be self-learning by the respective trainers. The ERS in the institution was installed in 2006. It means whoever joins the METI after that has missed the opportunity to attend the formal training. Even the current person in charge of the ERS has never received formal training, only learning from the previous senior lecturer how to operate the ERS as a learning and assessment tool.

P1 mentioned that in 2017, the METI purchased a High-Voltage Simulator, a small portion of ERS. Some of the current trainers in the METI have received formal training after the simulator installation by the maker. Nevertheless, this small simulator uses a different system and platform than the old ERS they already have. The ERS system is more complex compared to the High-Voltage simulator.

Key question	**Answers from participants**
What are the challenges to implementing the usage of ERS as an assessment tool in METI, and how educators overcome them?	**Challenges** • The trainers need to be well-trained to operate the ERS (P1, P3, P4) • Inadequate resources such as simulator experts, time and the number of simulator workstations. (P1, P4) • Trainers need to spend long hours operating ERS to become experts. (P1, P4) • Familiarity of the students and trainers with the complex system of ERS. (P1) • Resistance by various parties due to increment of the cost. (P2, P4) • Sceptical towards changes. (P2) • Poor digital literacy, especially by the older generation. (P2, P4) • Equipment failure while handling the ERS. (P1)

Table 4: Summary of information related to the RQ3

The trainers from FAME faced many challenges that caused low utilisation of ERS. As the ERS is managed by another department and solely used to generate revenue for the institution, other lecturers find it difficult to coordinate its usage. To become experts, the trainers must spend long hours operating the ERS. As an older generation previously dominated the METI with a lack of digital literacy, the learning process of handling the ERS was even more difficult.

As a result, the lecturer from FAME often asks for help from the simulator department to do the training on their behalf. Due to a lack of resources such as simulator experts, time and also the simulator workstation, the ERS sessions are not properly structured. The students may only utilise them whenever the dedicated ERS trainer is available.

4.4 Sustainability of ERS

Due to METI being a private institution, the issue of cost was highlighted by most participants. Currently, ERS is categorised as a high-end teaching tool, which incurs a high price to the end users.

Many agreed that the restriction is due to the non-obligatory rule set by MARDEP on using the simulator in the COC programme. It effectively causes low demand by the end users. P4 highlighted that MARDEP must set the direction to make it compulsory for all METIs, including the sponsors. However, P1 disagrees with obligating the usage of ERS, as this will increase the financial burden for other METIs, especially those that operate at a lower budget. P1 and P2 believed that METI should be able to convince the stakeholders concerning the effectiveness of ERS so that it will be utilised even though there is no obligation and it is pricey.

Key question	Answers from participants
How do we sustain the implementation of ERS as an assessment tool for METI?	• Diversify the sources of income using ERS to generate revenue. (P3) • METIs to convince various parties concerning the effectiveness of ERS. (P2) • The direction by MARDEP becomes a commitment by all parties. (P4) • ERS utilisation to be put as KPI criteria. (P4) • Internal sharing sessions by ERS experts to train other educators in ERS usage. (P4) • The usage of cloud simulation to increase the contact hours of ERS (train anywhere and anytime). (P1, P2) • METIs to convince various parties concerning the effectiveness of ERS. (P2)

Table 5: Summary of information related to the RQ4

P4 also suggested that using ERS should become part of the key performance index (KPI) to encourage all trainers to use it. Once it is practised by all trainers, ERS could easily become the preferred assessment tool. A sharing or ‘echo’ training session on using ERS could be done among trainers to increase awareness and encourage use. This may speed up the learning process of other trainers at a minimum cost. P1 and P2 mentioned the usage of cloud simulation may help in the self-learning process for both trainers and students, as the concept is to learn ‘anywhere at any time’.

As ERS is going to increase the cost, P3 suggested that all parties should optimise the usage of ERS and diversify the source of income using ERS to generate more revenue which subsequently will prolong the sustainability of ERS.

5.0 DISCUSSION

In this chapter, the researcher analyses, compares, and contrasts the results of this study with those of prior ones and discusses their implications, limitations, and contributions. It is the portion in which the researcher critically evaluates their study, identifying its merits and faults and recommending options for further research.

5.1 Planning and implementation of the change initiative

5.1.1 Planning

ERS, as an assessment tool, has grown immensely in popularity in maritime education and training, as they provide a safe and regulated environment for students to enhance their skills and knowledge (Cicek, 2017). This discussion will examine the process of creating and implementing an ERS as an assessment tool in a maritime school.

Preferably, incorporating ERS as a learning and assessment tool should be considered throughout the curriculum design and development (CDD) phase. According to the participants, the primary obstacles to administering ERS training are financial, personnel, and facility-related. Hence, planning is essential to guarantee that the resources are well utilised to prevent waste.

The course developer must comprehend the comprehensive CDD process, especially when considering the ERS as a learning tool. The definition of CDD is as follows:

- Curriculum design: defining the curriculum's fundamental components and their interrelationships.
- Curriculum development entails the methodical and well-organised preparation of what must be taught and learnt to build a complete curriculum plan (Yoga, 2018).

The ADDIE model originated in the United States of America and is among the most extensive yet basic models or frameworks in the CDD process (USA). ADDIE is an acronym for analysis, design, development, and implementation. This paradigm is frequently utilised by training and education developers such as the Open University of the United Kingdom (UK) (Bates, 2015). Figure 1 is a concept map showing an overview of the CDD process using the ADDIE paradigm. As shown in the figure, the usage of ERS in the TLA is influenced by a variety of factors, including:

- the learning objectives
- the target audience
- the available time
- the costs
- the workforce
- and the learning aids.

As all participants agreed that ERS only applies to certain areas, the initial stage is to determine the simulation's goals, which may range from basic familiarisation to advanced problem-solving and decision-making skills. Also, the METI must define the sorts of vessels and propulsion systems they seek to emulate and the level of realism necessary to obtain the desired results (Zaini, 2020).

After establishing the objectives, the METI must examine the space and equipment required to host the ERS. The ERS must imitate the layout and systems of the vessels in the METI's curriculum and be equipped with realistic controls, instruments, and displays (Laskowski et al., 2015b). In addition to real events and malfunctions, the ERS should give learners a realistic and ergonomic learning environment.

5.1.2 Implementation

The implementation of an ERS includes the installation and testing of the simulator, the formulation of training programmes, and the evaluation of the performance of the learners (DNV-GL, 2020). During the installation and testing phase, the institution must confirm that the ERS is correctly installed and that all systems and controls are calibrated and operational.

The next stage is to run training programmes that utilise the ERS as planned in the CDD phase in the previous subchapter. The training programmes should be aligned with the ERS's objectives and developed to address the needs of learners with varying degrees of experience. Learners should be able to practise their abilities and receive feedback on their performance, and programmes should incorporate theoretical and practical components. METI should establish an effective ERS learning process before it can be used as a formal assessment tool. For a start, the METI may use the ERS as the formative assessment tool, either the assessment of learning (AOL) or the assessment for learning (AFL), as a carry mark for the final grades. Once the METI is comfortable with the system and various parties are convinced of its effectiveness, this ERS may be used for summative assessments.

5.2 The effectiveness of the change initiative

Using ERS as a maritime education and training assessment tool has recently acquired substantial traction. Without the hazards and costs of running actual training ships, ERS provides trainees a safe and controlled environment to practise and enhance their skills and knowledge (Sellberg & Viktorelius, 2020).

As ERS is designed to simulate the real-world atmosphere of a ship's engine room, it also provides learners with a realistic and difficult educational experience. The simulators can be programmed to represent many types of ships and propulsion systems, and they can include

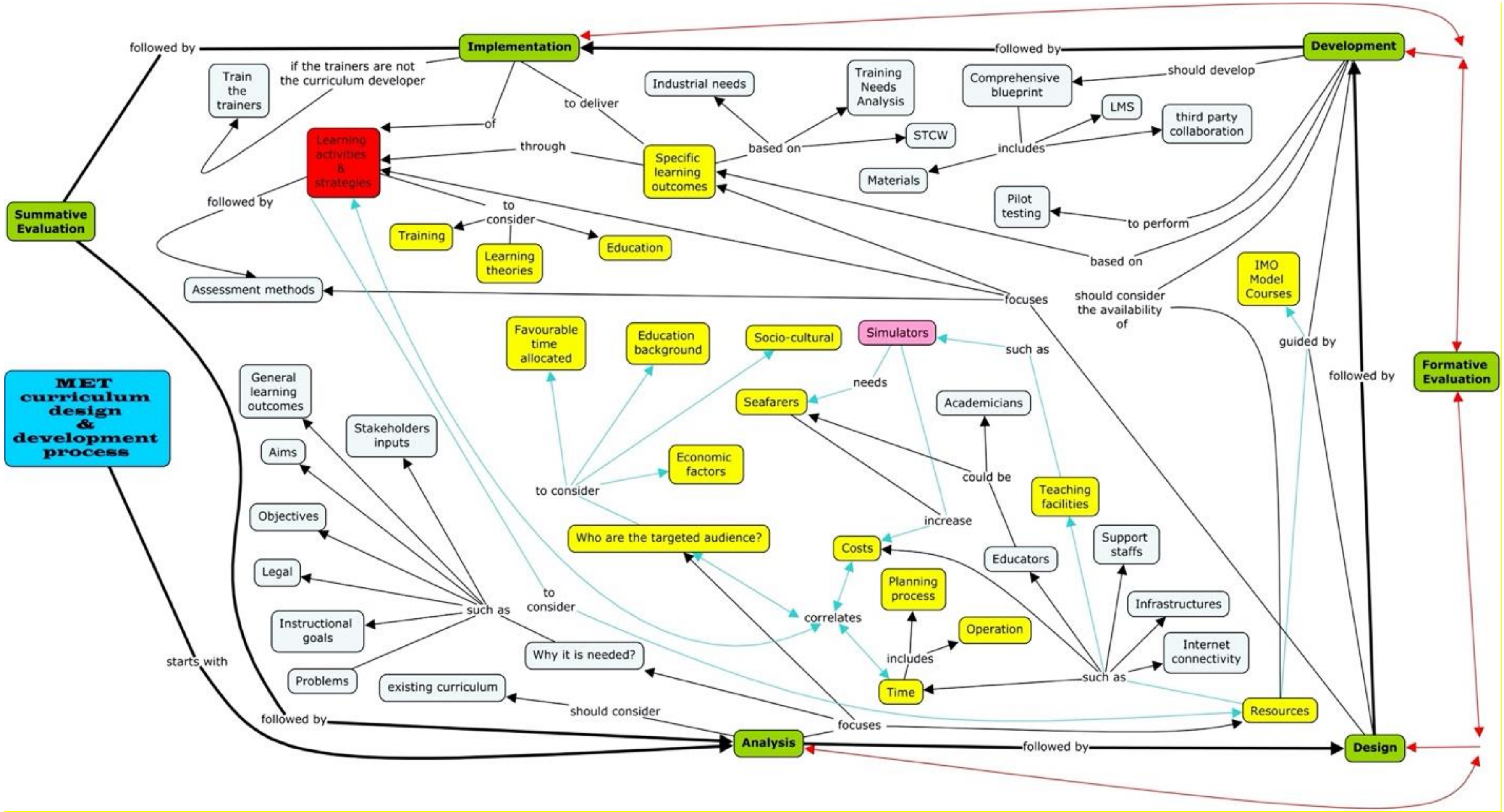

Figure 1: Concept map for METI curriculum design and development

Note. The figure illustrates the ADDIE approach to curriculum design and development. The key components of the ADDIE methodology are labelled in green. The yellow boxes represent the main factors determining ERS selection as a learning aid during the red-labelled procedure. Reproduced from *The Effectiveness of Engine Room Simulator (ERS) as a learning tool in maritime education and training* by Z. Zaini (https://commons.wmu.se/cgi/viewcontent.cgi?article=2390&context=all_dissertations). Copyright 2020 by World Maritime University realistic scenarios and faults to evaluate students' ability to troubleshoot and make judgements under duress. By giving learners hands-on experience in a realistic setting, ERS can improve their learning outcomes and prepare them for real-world scenarios (Stetsenko & Stetsenko, 2019).

Safety is one of the major benefits of utilising ERS as an assessment tool (Kluj, 2012). The ERS provides a controlled and risk-free environment for students to practise their skills and knowledge without endangering themselves, the vessel, or the environment. Learners can practise dealing with various scenarios and malfunctions without the inherent dangers of running actual ships, hence lowering the likelihood of accidents and casualties.

Traditional assessment techniques, such as aboard or shore-based training, are far less efficient than ERS (Bakalov, 2019). As learners can practise and develop their abilities in a simulated environment, using ERS decreases the time and cost associated with onboard training. In addition, ERS can be used to assess learners' abilities and knowledge quickly and accurately, enabling instructors to discover areas for development and modify training programmes.

ERS allows an objective evaluation of the abilities and knowledge of students, avoiding the possibility of subjective evaluations. ERS can monitor and record students' performance, producing data that may be used to assess the efficacy of training programmes and the ERS as an assessment tool (Cicek, 2017). By offering objective evaluations, ERS can improve the precision and dependability of the assessment process.

5.3 Critical factors for the sustainability

Several essential elements determine the viability of an ERS as an assessment tool in a METI. These elements must be considered to guarantee that the ERS continues to suit the demands of students and instructors and stays an effective and valuable tool over time.

Most participants highlighted that the available resources are the most important critical factor for sustainability. Cost-effectiveness is a crucial aspect of its long-term viability. The ERS must be constructed to maximise cost-effectiveness, balancing purchase and maintenance expenses with its benefits. Besides, ERS is a complicated system requiring routine maintenance and support to ensure its functioning and reliability (Mallam et al., 2019). A maintenance and support plan that includes routine inspections, updates, and repairs is vital. This maintains the ERS's continued functionality and dependability over time, decreasing the risk of downtime and lost training opportunities. In addition, the ERS must be utilised efficiently to minimise downtime and maximise the number of students who can use it. The METI should be creative to secure funding or generate revenue for the sustainability of the ERS.

For the ERS curriculum to remain successful and relevant, it must be continuously examined and updated to match the demands of learners and the changing industry standards (Lovren & Popović, 2018). The curriculum must be adaptable to industry changes and incorporate the most recent trends and technologies. This guarantees that students have the skills and knowledge required for success in the real world. Using up-to-date technology is one of the most important criteria for the long-term viability of an ERS. The ERS must be developed to imitate the most up-to-date vessel and propulsion systems, using the most up-to-date technologies and features. This guarantees that students are trained on the latest equipment and equipped for real-world scenarios. The latest technology may also influence other stakeholders concerning the benefits and necessity of using ERS as an assessment tool. Perhaps, there will be less resistance by the clients and even invite more parties to give funding to sustain the usage of ERS.

The ERS must be fully utilised by integrating it with the learning environment. To give a holistic learning experience, the ERS should be utilised in conjunction with other teaching methods and materials, such as classroom lectures and hands-on training. Also, the ERS should be accessible and simple to operate, guaranteeing that students can utilise it without extensive training or assistance.

Although under international regulation through the STCW convention, simulator assessment is not mandatory (International Maritime Organization, 2017b), it doesn't mean Malaysia, as a developing country, cannot surpass the minimum requirements. Perhaps, it will be more helpful if the MARDEP itself sets stringent enforcement to obligate the usage of this instrument in both training and assessment.

6.0 CONCLUSIONS

Planning and deploying an ERS assessment tool in a METI must consider the institution's demands, resources, and objectives. The successful execution of the simulator is contingent on the planning quality, the selection of suitable hardware and software, and the creation of efficient training and assessment programmes. Employing an ERS as an assessment tool can improve the quality of maritime education and training and the skills and knowledge of students.

ERS are an effective evaluation tool for marine training and education. The ERS provides a secure and controlled environment for students to practise and improve their skills and knowledge, improve learning outcomes, promote safety and efficiency, and provide objective assessments. As a result, ERS has become an integral part of METI, providing students with a practical and realistic learning environment that prepares them for real-world scenarios. It also helps to enhance the digital literacy of the students, which prepares them to adapt better to the rapid-evolving technologies.

The sustainability of an ERS as an assessment tool is contingent on several essential factors. These characteristics include cost-effectiveness, up-to-date technology, maintenance and support, relevant and flexible content and integration with the learning environment. By addressing these aspects, educators can guarantee that the simulator remains an effective and important maritime education and training tool. The approach should be holistic as all parties, such as maritime administration (MARDEP), shipping companies and METIs, should work together to ensure sustainability.

The results do not reflect the global use of ERS as an assessment tool due to the limited sampling region, a small number of participants, and time constraints.

In light of the findings, several suggestions for future research are given, including the following:

- Pedagogy of ERS assessment.
- Variety of assessment approaches using ERS.
- Cost optimisation of the ERS.

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