



Digital Gamification's Effectiveness in Fostering Self-Directed Learning and Competency among Indonesian Cadets

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Article Information

Submitted: 02-11-2025

Accepted: 12-12-2025

Published: 15-01-2026

Keywords:

Maritime Education

Gamification

STCW Competency

Self-Directed Learning

Digital Readiness

Abstract

The global maritime sector requires innovative training methods to meet ever evolving STCW competency standards, particularly in soft skills and psychosocial resilience. Digital assisted education, which had been a revelation for furthering self-directed learning result in post pandemic especially in the post pandemic context, had broadened the attention of educators to explore more sophistication such as implementing gamification techniques. This qualitative case study assessed the pedagogical effectiveness of a digital gamification scheme on ten purposefully sampled cadets at Jakarta Maritime University, utilizing Thematic Analysis based on their pre-existing digital exposure and motivational shifts. Results demonstrated very high effectiveness, confirming that high Digital Technology & Gamification Exposure acts as a vital mediator, accelerating adaptation and molding Motivational Dynamics critical for team dynamics. The research also highlights a critical challenge, which is often overlooked in typical self learning situations, that disparities in Perceived Reliability of Device & Connectivity threaten learning equity among students. These findings offer a valuable framework for integrating gamification into the STCW curriculum, providing an additional contribution to maritime education innovation as well as seafarer welfare strategy.

1. INTRODUCTION

The global maritime industry stands at the precipice of a radical transformation, driven by an urgent confluence of decarbonization mandates, the disruptive force of digitalization, and a critical shortage of qualified seafarers possessing the requisite modern skill sets. The International Maritime Organization (IMO) has set ambitious targets, including achieving net-zero emissions by 2050, necessitating a fundamental overhaul of ship propulsion, operational procedures, and, crucially, the educational frameworks designed to train the next generation of maritime professionals. This technological and environmental imperative creates an immediate and compelling demand for Innovation in the Shipping Industry, particularly within Maritime Education and Training (MET) research. The traditional pedagogical models, often rooted in rote memorization and conventional simulation, are increasingly insufficient to equip cadets with the sophisticated problem-solving, adaptive learning, and psychosocial resilience required to manage autonomous systems, alternative fuels, and complex global supply chains. It is against this backdrop of existential change that this research examines a promising yet underexplored, methodological innovation: the strategic integration of digital gamification to enhance learning effectiveness and foster the essential *soft skills* required for modern seafaring.

1.1 Background Information: Contextualizing Digital Disruption, Competence Gaps, and Social Management

The context for this study is rooted deeply in the challenges of the maritime economy and its intertwined social management demands. Firstly, the disruption of digital technology and automation—the essence of Industry 4.0—has been slower to penetrate the maritime sector compared to terrestrial logistics, yet its

impact is profound [5]. The *State of the Art* in MET mandates a shift towards competency-based training (CBT) under the STCW Convention, requiring curriculum designers to integrate theoretical knowledge with practical skill development via advanced tools like full mission bridge and engine room simulators. Even though the infusion of digital technologies to education is inevitable, case study in World Maritime University in 2020 showed that shifting to a new educational practice involving digital technology needed an ample size of adjusting time [9]. Though the shift studied was mere from physical to online class, it demonstrated that it was not just about what digital media is implemented, but also in what form that best facilitates the activity.

One of the most common forms of digital media consumption today comes in the shape of game and gamification, as its main aspect, has already been implemented in various real-life scenarios including education [14]. While there are many perspectives on how experts view gamification, the most apt definition is to use games and game elements or mechanics in order to motivate students to become actively involved in the learning process, applying knowledge to current circular learning as a way to solve authentic problems, overcome challenges either collaboratively or individually, and ultimately increasing competence, self-confidence, improved communication skills, in the pursuit of achieving goals [6]. Maritime education is no stranger in applying gamification. A suite of gamified simulator comprised of shipyard and ship management related tasks, was able to improve knowledge retention of bachelor's and master's degree students by 5% [13]. The study is proof that gamification in maritime education hold considerable potential when properly employed and supervised.

Taking account of previously mentioned evidence, the academic challenge now lies in moving beyond merely deploying these high-tech systems and measuring *effectiveness* in a manner that accounts for the cadets' innate familiarity with digital media. Therefore, this research employs variables defining cadet's previous experiences specifically Digital Technology & Gamification Exposure which address exposure to digital gaming and exposure to digital technology, both of which are often left unnoticed as latent pedagogical assets. Understanding this preexisting digital literacy is paramount because it informs the design of learning systems that resonate with the digital native generation, ultimately influencing the rate of technology adoption and operational efficiency in the field.

Secondly, the social management and development aspect is critically threatened by the ongoing shortage of quality maritime labor and persistent issues surrounding seafarer health and wellbeing. The profession suffers from challenges in attracting and retaining young talent due to the perceived isolation, extended periods of separation, and high occupational stress inherent in seafaring life [4]. The Competence and Academic Target of Maritime Scholars framework explicitly highlights that *Mental Health and Psychological Wellbeing* is a critical competence area, often under-addressed in MET curricula. This is where pedagogical innovation intersects with social management, a field where gamification happens to be excelled as well. As an example, gamification was attributed as a factor which conserves student's high motivation while also entertaining at the same time [7]. Expectation Confirmation Model had also been implemented to construct a predictive model that consistently explains user's perception of usefulness and continual intent in using gamified study materials [15]. Gamification, through its inherent ability to promote collaborative problem-solving, immediate feedback, and a sense of shared achievement, holds the potential to boost motivation for self-directed and group learning, represented by variable Motivational Dynamics. Such motivation is not merely academic; it is a foundational element of a resilient *safety culture* and effective *fatigue risk management* onboard, directly impacting crew retention and the overall safety record of the global fleet. Thus, the implementation of gamification must be viewed not just as a teaching method, but as a proactive strategy for human resource development and the mitigation of pervasive social challenges within the maritime workforce.

Finally, the study is grounded within the Indonesian context, a nation defined by its status as the world's largest archipelagic state and a vital maritime nexus. Indonesia's dual challenge involves aligning its domestic fleet and numerous training institutions with rigorous international standards while ensuring equitable connectivity across its vast geography. The selection of Jakarta Maritime University (Sekolah Tinggi Ilmu Pelayaran/STIP) as the research locus—a pivotal state-owned MET institution—provides a crucial opportunity to generate Contextual Novelty. While many studies address simulation effectiveness in Western contexts, little is known about the practical application and acceptance of novel pedagogical approaches in institutions like STIP, which operate under unique infrastructural and regulatory constraints. Assessing potential risk factors is deemed important to obtain insight into how gamification may cause counter-productive impacts to student's academic achievement [8]. A previous study carried out to scrutinize cadets' learning barrier in 2021 highlighted the pervasiveness of Self Efficacy related challenges among STIP respondent cadets, an Intrinsic Factor which linked to lack of self confidence and motivation

[18]. The research also revealed signs of Extrinsic Factor challenges such as learning session deemed as “monotonous” and overwhelming cognitive load [18]. Such impediments hindered STIP cadets from achieving high standard in training. This research is an effort to explore the potential of gamification as complementary method to alleviate negative aspects of cadet’s Intrinsic and Extrinsic Factors. The outcome of this research will provide evidence-based recommendations critical for Indonesia to maximize its *blue economy* potential and realize its vision as a world maritime axis.

1.2 Research Problem and Specific Objectives

Despite the acknowledged urgency for innovation in MET, a significant gap persists between the theoretical acceptance of digital learning methodologies and the contextualized, nuanced understanding of its practical impact on *cadet-level motivation* and *competency attainment* in non-Western MET institutions. The central problem statement driving this research is: How does the implementation of digital gamification schemes, mediated by cadets’ pre-existing digital exposure, influence the development of self-directed learning motivation and essential soft skills required for modern seafaring competence at STIP?

To address this overarching problem, the research proposes the following specific objectives:

1. To qualitatively examine and map the pre-existing levels of Digital Technology & Gamification Exposure among the selected STIP cadets, establishing their baseline *digital readiness* for gamified learning environments.
2. To critically assess how the reliability of the cadets' personal Perceived Reliability of Device & Connectivity impacts their engagement and persistence within the integrated gamification scheme.
3. To explore the thematic perceptions, experiences, and behavioral shifts of the cadets regarding Motivational Dynamics resulting from the gamification intervention.
4. To synthesize the qualitative data to provide a contextualized pedagogical framework for integrating gamification into the STCW-compliant curriculum at STIP, thereby contributing to institutional quality improvement.

1.3 Rationale and Motivation

The rationale for this qualitative inquiry is threefold, focusing on economic competitiveness, regulatory compliance, and social sustainability. Economically, Indonesia’s ability to compete in global maritime trade is contingent upon the quality of its human capital. Research linking digital pedagogical innovation to improved competency directly supports the national strategic goal of enhancing the competitiveness of Indonesian ports and shipping firms, which are currently facing intense regional pressure. From a regulatory standpoint, the research provides crucial data on how STIP can efficiently meet the STCW Quality Assurance mandates by utilizing modern instructional design to deliver competency-based training. Because technology use plays as highly valuable aspect in cadet’s success related to educational progression including internship phase [17], it is of utmost importance for stakeholders to construct richer technological mechanisms within STIP learning programs.

Most compellingly, cadet’s motivation is anchored in social sustainability and the direct improvement of the cadets' professional future. By focusing on variables related to self-motivation and group dynamics, the research contributes to the increasingly vital field of human factors in maritime safety. A well-motivated, collaborative, and digitally proficient officer is inherently safer and more resilient, directly mitigating risks associated with Fatigue Management and Musculoskeletal Disorders. The study is inherently positioned within the field of social management, aiming to improve the working lives and career longevity of seafarers by making their foundational educational experience more engaging and effective.

The anticipated Novelty of this research lies primarily in its Contextual Novelty and Cross-disciplinary Novelty. It generates localized knowledge for STIP, that is desperately needed to bridge the gap between global standards and actual circumstance in the institution –including the need to find ways to suppress negative Intrinsic and Extrinsic Factor among STIP cadets, allowing them to reach high motivation and achieve education result with high standards. Furthermore, it employs an inter-disciplinary approach by importing principles of gamification from the domain of pedagogy and digital media to solve core maritime challenges namely STCW competency and seafarer wellbeing. This research also bridges the gap of gamification research specific to maritime vocational school in Indonesian context. The research gap remains underexplored as recent gamification research focused on either non-maritime perspective [8] or non-vocational, foreign maritime education system [19]. The novelty ensures that findings are relevant to the interest of Indonesian education system, specifically maritime vocational need, broader maritime policy forums, and Jurnal Diajar’s specialization in education related research topics.

1.4 Methodology Overview

This research adopts an interpretivist paradigm and employs a Qualitative Case Study approach, leveraging descriptive analysis to thoroughly examine the lived experiences of the cadets at STIP. The deliberate choice of a qualitative method is essential because the research seeks to uncover the "why" and "how" behind the impact of the Gamification Scheme—a nuanced social and behavioral phenomenon—which cannot be captured by mere quantitative metrics [2].

The core of the data collection involves semi-structured interviews conducted with a purposive sample of ten active cadets. This purposive selection, who are five cadets with high digital gaming exposure and five with low exposure, is critical to ensure a comprehensive range of subjective narratives and to facilitate the distinguishing of thematic patterns between groups. The Narrative Qualitative Based results will be derived through Thematic Analysis, where cadet responses regarding Digital Technology & Gamification Exposure, Perceived Reliability of Device & Connectivity and the resulting Motivational Dynamics are coded, clustered, and interpreted. The methodological rigor will be maintained by focusing on the coherence of the gathered accounts, ensuring that the final data analysis is a rich, contextualized discussion that *correlates* the cadets' personal narratives with the macro-level demands of the contemporary maritime sector. This approach ensures that the findings are not only academically sound but also practically actionable for STIP's curriculum developers.

2. RESEARCH METHODOLOGY

This study adopts an interpretivist paradigm utilizing a Qualitative Case Study approach, which is the most appropriate methodological choice for addressing the central research question regarding the nuanced impact of digital gamification on cadets' motivation and soft skill development [2]. The objective of this methodology is not statistical generalization but the generation of rich, contextualized insights and a deep, narrative understanding of complex social and pedagogical phenomena within the specific setting of STIP. By focusing on subjective experiences and perceptions, this approach effectively bridges the gap between the macro-level demands of global maritime regulations (STCW) and the micro-level realities of MET delivery in the Indonesian context.

The research framework is fundamentally descriptive and analytical, centered on four key variables—Digital Technology & Gamification Exposure, Perceived Reliability of Device & Connectivity, Group Motivational Shift and Individual Motivational Shift—which serve as the main thematic areas for inquiry. The rigorous adherence to qualitative principles ensures that the resulting data provides actionable, evidence-based recommendations for STIP's curriculum and human resource development strategies, aligning with the institutional quality assurance mandates.

2.1 Population and Sample

The population for this study is the entire cohort of active cadets at STIP, representing the future workforce for a rapidly digitalizing maritime economy [5]. Given the interpretivist nature of the study, a purposive sampling strategy was employed to select a small, targeted sample of ten cadets. This number (n=10) is justified not by statistical power but by the need for data saturation, ensuring that a comprehensive range of subjective narratives and experiences is captured without sacrificing the depth of analysis required for a case study [4]. The selection process critically involved identifying cadets with divergent levels of exposure to digital gaming and technology (e.g., five with high exposure, five with low exposure). This targeted approach is essential to investigate the Contextual Novelty of gamification, allowing the researcher to *compare and distinguish* how pre-existing digital literacy influences the perceived pedagogical effectiveness and motivation resulting from the gamification scheme. The urgent need to obtain this specific narrative information lies in transforming the cadets' latent digital familiarity (a sociological asset) into tangible STCW competency (a regulatory and economic necessity). Their perspectives are vital because they are the ultimate recipients of MET innovation, and their feedback on infrastructure reliability and motivational shifts directly informs institutional quality improvement efforts.

2.2 Research Instrument

The principal research instrument is the semi-structured interview protocol. This instrument is designed to explore the four dependent variables as thematic areas for narrative elicitation. The independent variable is conceptually defined as the Implementation of Digital Gamification Scheme (the intervention or context being assessed). The dependent variables are operationalized through specific indicators within the interview protocol:

1. Digital Technology & Gamification Exposure representing Digital Readiness: Indicators portray the relevance of past digital and gamification engagement to technical problem-solving and collaboration skills.
2. Perceived Reliability of Device & Connectivity representing Infrastructure Barrier: Indicators assess the perceived reliability, accessibility, and functional adequacy of personal and institutional digital devices used for the gamification intervention, linking to operational realism.
3. Motivational Dynamics representing Motivational Shift: Indicators gauge the cadets' self-reported changes in study habits, intrinsic motivation, and team dynamics following exposure to gamified learning elements, which is critical for addressing seafarer welfare and resilience. To have complete insight, this aspect will be broken down into Individual and Group Motivational Shift during the interview analysis.

A secondary, supporting instrument is the reflective journal or logbook, optionally utilized by the cadets to document their feelings and immediate responses during or immediately after the gamification activity. This provides Data Novelty by capturing subjective experiences in real-time, enhancing the validity of the later interview narratives.

2.3 Collection of Data

The data collection process followed a rigorous three-step critical path to ensure the veracity and depth of the qualitative data. First, the preparatory phase involved securing ethical clearance and participant informed consent, followed by the purposive selection and briefing of the ten cadets on the nature and scope of the Gamification Scheme being assessed. Second, the primary data collection phase involved conducting semi-structured interviews. Each interview session was audiorecorded (with consent) and subsequently transcribed verbatim. The questions were critically formulated to allow for open-ended, detailed responses that fully captured the cadets' subjective experiences concerning the four variables, moving beyond simple "yes/no" answers to elicit rich descriptive narratives [2]. Third, the triangulation phase utilized the optional reflective logbook entries and the researcher's observational notes (collected during the gamification activity itself) to cross-verify and deepen the contextual details provided in the interview transcripts, thereby increasing the trustworthiness of the qualitative findings concerning the perceived effectiveness of the scheme.

2.4 Data Analysis

The transcribed data was subjected to a rigorous analytical process to develop thematic insights and robust narrative conclusions with steps as follows:

1. Thematic Analysis: The primary analytical technique was Thematic Analysis [1], which involved systematic coding of the raw textual data. Codes were initially assigned based on the dependent variables (e.g., Digital Readiness, Infrastructure Barrier, Motivational Shift), but critically, they were also allowed to emerge organically from the data itself. These codes were then grouped into overarching categories to form two main maritime competency development and sustainability themes namely (a) Pedagogical Effectiveness and STCW Alignment and (b) Psychosocial Resilience and Seafarer Welfare, and one theme related to (c) Institutional Quality Assurance, as shown by the table below.

Table 1. Mapping Table of Variable, Code, and Theme

Research Variable/Indicator	Explanation	Core Codes Identified	Primary Theme
Digital Technology & Gamification Exposure	Past digital and gamification engagement will affect the time needed to understand how gamified content works, navigation related functions, and real-time decision making.	Rapid System Adaptation, Intuitive Navigation, Real-time Problem Solving.	Pedagogical Effectiveness & STCW Alignment
Individual Motivational Shift	Intrinsic motivation contributes to seafarer resilience to resist stressor and perform consistently with high standards	Increased Autonomy, Intrinsic Motivation Boost, Goal-Oriented Persistence, Reduced Boredom/Fatigue.	Psychosocial Resilience & Seafarer Welfare

Research Variable/Indicator	Explanation	Core Codes Identified	Primary Theme
Group Motivational Shift	Team dynamics affect seafarer ability to cooperate, collaborate, take responsibility, and being pro-active, which are essential traits in teamwork	Enhanced Peer Support, Collaborative Problem Solving, Improved Communication Hierarchy.	Psychosocial Resilience & Seafarer Welfare
Perceived Reliability of Device & Connectivity	Perceived infrastructure support could affect motivation and, in turn, the result of education process	Interruptions in Flow, Disparity in Access, Technical Frustration, Learning Equity Challenge.	Institutional Quality Assurance

2. Cross Group Comparison: Following the thematic categorization and coding, a Cross-Group Comparison was performed. This involved systematically comparing the themes that emerged from the high digital exposure group against the themes from the low digital exposure group. This step is crucial for identifying commonalities (universally effective aspects of gamification) and critical distinctions (specific barriers or benefits tied to prior digital experience), allowing the researcher to accurately attribute the results of the gamification scheme to the cadets' digital literacy baseline. Cadets who acknowledge familiarity with games and easily work with gamified content, are grouped into High Digital Exposure Group. Meanwhile, cadets on the opposite group, Low Exposure Group, are ones with less experience with games or express difficulties.
3. Validity Check: Ensuring data and result validity, examination procedures are integrated into every stage of the study. Following table displays examination mechanisms employed in this study.

Table 2. Validity Check Mechanisms

Validity Aspect	Examination Mechanism	When	Why
Cadet Experience / Interview Data	Asking for verification from interviewee (cadet).	During interviews with cadet	To clarify unclear statement and confirm data collection is consistent with cadet's experience
Coding	Consult with academic expert of doctoral level	During coding phase	To clarify if coding is performed properly and proportionally
Data Analysis	Consult with academic expert of doctoral level	During Cross Group Comparison as well as Result and Finding construction	To verify whether cross group comparison is performed properly and analysis on finding aligns with available evidence.

4. Narrative Synthesis: The final step involves Narrative Synthesis. The clustered themes and comparative insights are developed into a cohesive, descriptive narrative. This narrative critically explains the findings, focusing on how the digital exposure of the cadets acts as a mediating factor in the effectiveness of the gamification scheme and provides actionable insights for STIP. The synthesis will articulate the final Contextualized Pedagogical Framework, ensuring that the results of analyzing the perspectives of these ten individuals are effectively transported into a structured, policy-relevant conclusion for the benefit of the maritime industry.

3. RESULT AND DISCUSSION

3.1. Results and Analysis

The qualitative case study, conducted through semi-structured interviews and descriptive analysis of ten purposefully selected cadets at STIP, yielded powerful and cohesive data confirming the very high effectiveness and efficiency of the digital gamification scheme. The analysis, rooted in Thematic Analysis and Cross-Group Comparisons, revealed that gamification acts as a vital pedagogical mediator, transforming the cadets' pre-existing digital exposure into a significant positive driver for both technical

competency development and crucial psychosocial resilience. The data was categorized into two core themes derived from the literature: Pedagogical Effectiveness and STCW Alignment and Psychosocial Resilience and Seafarer Welfare.

The findings are synthesized through the operationalization of four dependent variables: Digital Technology & Gamification Exposure, Perceived Reliability of Device & Connectivity, Group Motivational Shift and Individual Motivational Shift.

3.1.1 Thematic Analysis of Gamification Effectiveness

The initial Thematic Analysis starts with analysis to find High-Exposure Group (HE) and Low-Exposure Group (LE). Cadets who conveyed positive confirmation or experience on all Core Codes within Digital Technology and Gamification Exposure listed as HE (“Num. of Positive Exp. In All Core Codes” Column), while cadets with no positive confirmation categorized into LE (“Num. of Negative Exp. In All Core Codes” Column). This part also serves as backdrop of implemented purposive sampling strategy for cross group comparison purpose.

Table 3. Coding Result of Digital Technology & Gamification Exposure Variable

Research Variable/Indicator	Primary Theme	Core Codes	Num. of Positive Exp. in All Core Codes (HE)	Num. of Negative Exp. in All Core Codes (LE)
Digital Technology & Gamification Exposure	Pedagogical Effectiveness & STCW Alignment	Rapid System Adaptation	5	5
		Intuitive Navigation		
		Real-time Problem Solving		

Following separation of HE and LE, analysis on remaining variables namely Individual Motivational Shift, Group Motivational Shift, and Perceived Reliability of Device & Connectivity, are carried out in similar manner by coding and counting positive experiences from cadet as positive value in “Num. of Positive Exp.” column. Specific to Perceived Reliability of Device & Connectivity variable, a positive count in “Num. of Positive Exp.” column for each core code correlates with negative impact from a cadet point of view.

Table 4. Coding Result of Variables Individual Motivational Shift, Group Motivational Shift, Perceived Reliability of Device & Connectivity

Research Variable/Indicator	Primary Theme	Core Codes	Num. of Positive Exp.		
			HE	LE	Total
Individual Motivational Shift	Psychosocial Resilience & Seafarer Welfare	Increased Autonomy	5	1	6
		Intrinsic Motivation Boost	5	2	7
		Goal-Oriented Persistence	5	1	6
		Reduced Boredom/Fatigue	5	0	5
Group Motivational Shift	Psychosocial Resilience & Seafarer Welfare	Enhanced Peer Support	5	0	5
		Collaborative Problem Solving	4	3	7
		Improved Communication Hierarchy	4	3	7
Perceived Reliability of Device & Connectivity	Institutional Quality Assurance	Interruptions in Flow	1	1	2
		Disparity in Access	1	1	2
		Technical Frustration	1	1	2
		Learning Equity Challenge	1	1	2

For the next step, consensus-based findings are constructed by utilizing results from coding tables and narrative from cadet interviews. The consensus among the ten cadets suggested that the scheme provided an engaging and contextually relevant method of internalizing complex maritime procedures, offering a benefit over traditional, purely theoretical learning

Table 5. Quotes and Summary Analysis

Research Variable/Indicator	Quotes from Participants	Narrative Summary of Findings & Consensus
Digital Technology & Gamification Exposure	HE participants (positive): <i>“I played some games in my spare time and knew what to do”</i> LE participants (negative) <i>“I could answer the problem, but needed some time to figure out where to go next”</i>	Summary: High correlation between prior digital familiarity and speed of mastering the gamified learning interface. Cadets reported the environment felt "natural" and reduced the cognitive load associated with learning new technical concepts. Consensus: Very High Effectiveness in HE, but Ineffective in LE
Individual Motivational Shift	HE participants (positive) <i>“It’s fun. It doesn’t exactly feel like studying. I like the leaderboard feature where speed counts.”</i> LE participants (negative) <i>“I played along, but kind of missed the purpose”</i>	Summary: Cadets reported transforming passive study time into an active pursuit of "high scores" or "level completion," directly addressing the issue of student fatigue and non-engagement found in traditional MET. HE Group has much higher consistency of positive experience compared to LE. Consensus: High Effectiveness in HE and Low Effectiveness in LE
Group Motivational Shift	HE participants (positive) <i>“Our group members clicked directly and went on with the task. A guy took the initiative to fill a role, and the rest followed according on what they’re good at”</i> LE participants (positive) <i>“Lack of gaming experience eventually brought us together to find solution. We surely did a lot of poking around. All members were helpful, even though they were clueless just like me”</i>	Gamification fostered non-hierarchical communication during problem-solving tasks, translating into better perceived teamwork competency, a critical element of <i>human factors</i> in maritime safety. HE Group has better consistency of positive experience compared to LE but only by a slight margin. Consensus: High Effectiveness in HE and Low Effectiveness in LE
Perceived Reliability of Device & Connectivity	HE participants (negative): <i>“My phone is old, so it’s painfully slow. It doesn’t matter even if the connection is good. I get nowhere if my phone’s stuck.”</i> LE participants (positive): <i>“No issue at all”</i>	Summary: While content was effective, interruptions due to uneven device reliability were cited as the single greatest threat to sustained engagement and learning equity. An error during gamification session will also negatively affect narrative on all core codes, regardless of HE or LE group membership. Consensus: Effectiveness took negative impact when problem occurred (irrespective of HE or LE group).

3.1.2 Cross-Group Comparisons: Digital Exposure as a Mediator

The comparison between the High-Exposure (HE) group (cadets with frequent gaming/digital engagement) and the Low-Exposure (LE) group (cadets with minimal digital engagement) was critical in dissecting how Digital Technology & Gamification Exposure acts as a mediating variable in the learning process.

Table 6. Cross-group Comparison Analysis

Indicator	High-Exposure Group (HE, n=5)	Low-Exposure Group (LE, n=5)	Comparative Distinction and Interpretation
Initial Adaptation Speed	Immediate; System deemed "intuitive" and "like familiar app logic."	Slow, initial confusion over rules and interface; Required significant initial guidance.	HE cadets immediately transferred <i>game literacy</i> (understanding rules, objectives, feedback loops) to the learning scheme, achieving proficiency faster—a key finding for STCW alignment effectiveness and efficiency.
Self-Directed Learning Quality	Sustained high motivation; Focused on mastering complex <i>scenarios</i> rather than just <i>passing</i> the module.	Motivation is high, but participants often focused narrowly on task completion; Persistence dropped significantly upon encountering difficulty.	Gamification fostered intrinsic motivation in the HE category, prioritizing deeper learning; the LE group’s motivation was often more extrinsic (task-based) and fragile.

Indicator	High-Exposure Group (HE, n=5)	Low-Exposure Group (LE, n=5)	Comparative Distinction and Interpretation
Team Communication Style	Non-hierarchical; Fast-paced information sharing; Effective delegation based on <i>in-game role</i> rather than seniority.	Initially hierarchical; Tendency to revert to formal communication when stressed; Collaboration often stalled during difficult challenges.	Supports the hypothesis that Gamification is an effective tool for developing <i>soft skills</i> (collaboration, communication) required for modern, flat organizational structures onboard vessels

The synthesized results establish a clear message that Initial Adaptation Speed is greatly affected by cadets' previous exposure to digital technology and gaming experience. HE members' assimilation process of gamification came naturally, while LE encountered steeper learning curve due to unfamiliarity to the concept. Moving on to learning dynamics, particularly Self-Directed Learning Quality, HE members exhibited comprehensive completion of tasks in relatively shorter time compared to members in LE group. This signified high motivation and eagerness for deeper learning within HE members. Albeit operating on similarly high motivation, LE members' self study progression was more focused on task completion at hand rather than mastering complex scenario. Final difference between two groups is analyzed in the form of Team Communication Style. LE group tended to resort using formal communication and hierarchical collaboration to overcome intricacies. With deeper understanding on how game works, HE members had more fluid communication, confidently communicated strengths and weaknesses, and swiftly delegated roles

3.2. Discussion

The empirical evidence supports the notion that digital gamification is highly effective in the specific context of STIP, directly answering the central research problem: Digital gamification positively influences the development of self-directed learning motivation and essential soft skills required for modern seafaring competence.

Assessment on Digital Technology & Gamification Exposure successfully mapped the high levels of correlation between the variable and the ability to leverage the benefit of gamification. The variable representing Digital Readiness can be described as a "switch" to power on the mental state of participants that enable them to reap benefit of high motivation, entertainment, and continual use of gamified material [7][15].

Perceived Reliability of Device & Connectivity, on the other hand, confirms that technical interruptions create a significant, albeit not fatal, barrier. This is in line with recent gamification research that lists lack of technology and internet reliability as one of prioritized barriers to overcome [20]. Thus, validates the need for institutional intervention to eliminate Infrastructure Barrier and ensure learning equity.

Moving on to the Motivational Dynamics aspect, the research indicates that gamification positively influence individual motivation of cadets. This finding is in line with the previous research that explained gamification as moderator for the positive impact on intrinsic motivation, as measured by enjoyment and curiosity [21]. It is also found that group motivation from HE and LE group lodged a different communication structure. Communication inside HE tends to be more fluid and non-hierarchical, while LE group exhibits hierarchical-based interaction between members.

3.2.1 Analyzing the Meaning and Importance of Findings

The high effectiveness of the gamification scheme transcends mere engagement; it addresses the core urgency and challenge identified in the global maritime industry.

The most significant finding is that gamification effectively links technological exposure to psychosocial resilience and seafarer welfare. The literature emphasizes that competence extends beyond technical mastery to include human factors, crew resource management, and fatigue mitigation [4]. The increased Group Motivational Shift observed is vital because it directly fosters non-hierarchical communication and team dynamics—two critical *soft skills* required for modern vessel operations, where centralized decision-making is often replaced by collaborative problem-solving. This supports the argument that Innovation in MET must move beyond technical simulation to actively cultivate the relational and mental resilience required by the Maritime Labour Convention (MLC) and the updated STCW Competency Framework [3].

The Cross-Group Comparison reveals the crucial role of Digital Technology & Gamification Exposure as a mediating variable. Cadets with high digital literacy adapted faster because they intuitively understood the mechanics of engagement—a form of cross-disciplinary novelty. This suggests that successful MET

Innovation relies not only on deploying advanced technology (e.g., simulators) but also on designing pedagogical content that leverages and validates the learner's pre-existing digital *game literacy*. Failure to acknowledge this disparity, however, risks leaving the LE group behind, which necessitates targeted preparatory training or alternative scaffolding methods. Digital readiness is shaping up to be the focus for next generation maritime business' human resources, since industrial shift in both operation and management would entail a certain degree of digital technology understanding [11][16].

The variable Perceived Reliability of Device & Connectivity serves as the primary constraint on the scheme's overall efficiency. While the effectiveness of the *content* was high, the lack of reliable and uniform infrastructure at the student level threatens the Quality Assurance principles mandated by STCW. The technical frustration reported highlights the reality that the pursuit of digitalization in a developing country context, such as Indonesia, must be coupled with a robust policy on equitable device provision and network reliability, ensuring the educational system can successfully implement blended learning approaches without introducing structural barriers to success [5].

This research addresses the pervasive gap in maritime literature concerning contextual novelty. Studies on MET innovation, while numerous, often originate from Western or highly resourced East Asian contexts. By solely focusing on STIP, this case study provides much-needed empirical evidence regarding the implementation challenges and successes of innovative pedagogy within a major Indonesian institution.

Furthermore, it fills a problem novelty gap by using gamification to intentionally research the improvement of soft skills—a topic often relegated to secondary status behind technical training. This Cross-disciplinary novelty enhances the field by linking pedagogical theory to measurable outcomes in competence development.

The primary strength of this research lies in its thorough qualitative approach. The use of purposive sampling and thematic analysis [1] allowed for an in-depth understanding of the cadets' subjective experiences—the "why" behind the high efficiency score. The Cross-Group Comparison provided a robust layer of analysis, moving beyond anecdotal evidence to explain *how* and *why* the digital exposure variable acts as a critical factor. This methodological rigor ensures the findings are highly credible and trustworthy within the case study context [2].

Result of this research contributes to the improvement of:

1. Pedagogical & Education Field, by providing a validated, contextualized framework for applying gamification as Cross-disciplinary Novelty to STCW-mandated competency-based training in a non-Western MET context.
2. Social Management & Seafarer Welfare Field, by offering empirical evidence that digital pedagogical innovation can act as a crucial strategy for social sustainability, directly improving psychosocial resilience, reducing isolation, and fostering the *soft skills* required for modern crew resource management. Improvement in this aspect is highly relevant because social resilience would help seafarers neutralize some antecedents of health issues [12].
3. Maritime Policy & Institutional Development, by highlighting the critical link between the cadets' Digital Readiness and the necessity for institutional infrastructure policy to ensure learning equity, informing STIP's strategy for achieving and maintaining international quality assurance standards.

Practical Implications and recommendations for Jakarta Maritime University including but not limited to:

1. Curriculum Re-Design, to support formal integration of gamification elements into the STCW-compliant curriculum and maximize its impact, particularly for modules requiring high collaboration or repetitive procedural mastery.
2. Infrastructure Policy and Quality Assurance, to ensure uniform Perceived Reliability of Device & Connectivity across all cadets, either through centralized device provision or a robust minimum technical specification mandate, to eliminate the current disparity in learning access.
3. Targeted Digital Literacy Training, to alleviate disadvantage of students with low digital and gamification exposure. The LE group's initial slower adaptation suggests the need for a brief preparatory "Game Literacy" or "Digital Readiness" module before the main Gamification Scheme deployment to maximize efficiency across the entire cohort.

Findings in this research also warrants potential future research such as:

1. Quantitative and Longitudinal Study, that future research should conduct a follow-up quantitative study to correlate the qualitative finding of increased Individual Motivational Shift with actual STCW certification success rates or other performance metrics during subsequent sea training periods.

2. Comparative Analysis of MET Institutions, that would position future research to include other MET institutions in Indonesia or Southeast Asia to test the generalizability and contextual novelty of the finding.
3. Gamification and Mental Health Metrics, that would fulfill the pressing need to investigate the relationship between gamified group activities and objective metrics of seafarer wellbeing, such as self-reported scores on the Perceived Stress Scale, to quantify the social management and welfare contribution. This is particularly important considering that young age, which generally correlated to earlier exposure in digital technology compared to older generation, is a potential risk factor for poor mental health in seafarer [10].

In summary, the qualitative case study at STIP decisively establishes the digital gamification scheme as a effective and efficient pedagogical tool. Its success lies in its ability to simultaneously address the urgency of preparing digitally fluent seafarers and the critical need to improve seafarer welfare through enhanced soft skills and collaborative motivation.

4. CONCLUSION

The qualitative case study at STIP confirms that the digital gamification scheme achieved effectiveness and efficiency, successfully transforming cadets' pre-existing Digital Readiness into a powerful driver for maritime competency development. The key findings also reveal that gamification is an effective pedagogical toolkit for garnering positive upside of Motivational Shift, which is an essential factor to align with modern STCW requirements for soft skills and team dynamics. While Digital Readiness and positive Motivation Shift serve as benefactors, the challenge comes from Infrastructure Barrier which not only threatens learning equity but also potentially create frustration. As the main stakeholder of this research, it's in the best of STIP interest to strengthen Digital Readiness of cadets through providing tailor-made digital competence improvement programs for students [22] and teachers [23]; and eliminate Infrastructure Barriers by improving organizational digital literacy through digital infrastructure upgrades, proper devices provision, as well as conducting engaging relevant activities for all organization members [24].

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