

# Empowering 21<sup>st</sup>-Century Maritime Educators: Exploring the Relationship Between Technology Acceptance and Digital Citizenship in Cebu City

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The rapid integration of digital technologies in maritime education requires teachers to adopt digital tools aligned with 21<sup>st</sup> century pedagogical practices. This study examines the relationship between technology acceptance and digital citizenship among maritime teachers in Cebu City, Philippines, using the Technology Acceptance Model (TAM) as its theoretical framework. Employing a descriptive-correlational design, data were collected from 253 maritime teachers across higher education institutions in Cebu City, through a validated structured questionnaire measuring demographic characteristics, technology acceptance, and digital citizenship dimensions. Descriptive statistics, mean analysis, and multiple linear regression were performed to examine predictive relationships among the variables. Respondents were predominantly early- to mid-career teachers with varied teaching experience. They demonstrated high mean scores for technology acceptance ( $M = 4.015$ ,  $SD = 0.323$ ) and digital citizenship (all dimensions  $M > 4.00$ ), reflecting positive attitudes toward digital integration. Regression analysis revealed that only actual use of technology marginally predicts digital citizenship ( $\beta = 0.210$ ,  $p = 0.062$ ), while other TAM variables are not significant predictors. These findings suggest that, beyond personal acceptance, structural and institutional factors, such as access to simulation tools, e-navigation systems, and administrative support, significantly influence responsible digital engagement. The study highlights the importance of hands-on technological experience and comprehensive institutional support in developing digitally competent maritime teachers, thereby supporting effective 21<sup>st</sup>-century teaching in specialized, technology-intensive educational contexts.

## KEY WORDS

- ~ Technology acceptance
- ~ Digital citizenship
- ~ Maritime education
- ~ Maritime training
- ~ Maritime higher education

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## 1. INTRODUCTION

In the evolving landscape of maritime education, digital tool integration has become essential for equipping future seafarers with 21<sup>st</sup> century competencies. The increasing reliance of the global maritime industry on e-navigation systems, automation, and simulation technologies requires maritime teachers to not only adopt but also effectively incorporate these digital innovations into their teaching. This shift reflects a broader international trend in higher education, where digital transformation is becoming a benchmark for instructional quality and global relevance.

Numerous studies have examined the adoption of educational technology using the Technology Acceptance Model (TAM) (Davis, 1989), including its extended applications in various educational contexts (Šumak et al., 2011; Teo, 2011; Al-Adwan et al., 2023). TAM has been useful in understanding how perceived usefulness (PU) and perceived ease of use (PEOU) influence technology adoption among maritime teachers and students. In the Philippine context, research has highlighted the importance of institutional support, teacher attitudes, and digital readiness in promoting technology integration in general education settings (Padolina-Alcantara, 2023; Tanucan et al., 2022).

However, a critical gap remains in applying these models specifically to maritime education, which has distinct pedagogical demands. Maritime teachers must navigate a unique intersection of simulation-based instruction, international maritime regulations (e.g., STCW), and high-stakes technical competencies. While studies have examined digital learning in vocational and engineering fields (Alexandro & Basrowi, 2024; Carvalho et al., 2023), very few have explored how technology acceptance by maritime instructors translates into actual digital citizenship practices - a crucial dimension in professional ethics, legal compliance, and global communication.

Moreover, in the wake of the COVID-19 pandemic, higher education worldwide underwent rapid digital transformation. Although this transition has been widely documented in Western and East Asian contexts (e.g., Laufer et al., 2021; Karakose et al., 2021), empirical insights from Southeast Asia, particularly from maritime training hubs like Cebu City, remain scarce. This geographic gap limits how well global educational technology frameworks apply across different contexts, and marginalizes the perspectives of maritime teachers in high-export labor economies such as the Philippines.

This study addresses these gaps by examining how the core TAM constructs - Perceived Usefulness, Perceived Ease of Use, Behavioral Intention, and Actual Use - predict digital citizenship practices among maritime teachers in Cebu City. The findings are relevant not only for Philippine institutions but also for international stakeholders concerned with the global maritime workforce, digital teaching competencies, and the ethical use of technology in education. By situating this research within an underexplored yet globally significant sector, the study contributes to the broader discourse on educational technology, workforce development, and responsible digital engagement in specialized fields.

## 2. THEORETICAL FRAMEWORK

This study is based on the Technology Acceptance Model (TAM) proposed by Davis (1989), which posits that an individual's acceptance of technology is influenced by Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), which in turn shape Behavioral Intention (BI) and Actual Use (AU). TAM has been widely used in educational research to examine how teachers adopt and integrate digital tools into instructional practices. In the context of maritime education, TAM offers a framework for understanding how educators' perceptions of technology influence their engagement with digital resources, simulation tools, and e-learning platforms, thereby affecting their professional digital practices.

The study also draws on Digital Citizenship frameworks (Ribble, 2015), which emphasize responsible, ethical, and effective use of digital technologies, including digital access, communication, literacy, etiquette, and law. By integrating TAM and digital citizenship perspectives, the research examines how technology acceptance among maritime teachers predicts their responsible and competent engagement in digital environments.

## 2.1. Conceptual framework diagram

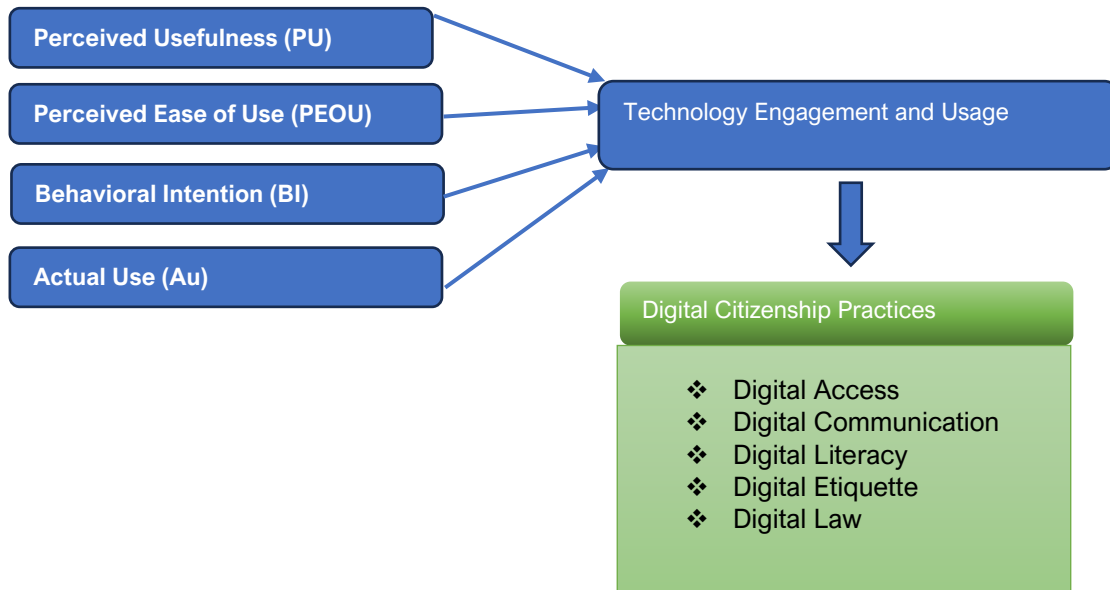


Figure 1. *Conceptual Framework Illustrating the relationship between technology acceptance and digital citizenship practices of maritime teachers.*

## 3. RESEARCH OBJECTIVES

**Q1: What is the demographic profile of maritime teacher respondents in terms of:**

- Age;
- Sex;
- Marital status;
- Highest educational attainment;
- Years in school teaching.

**Q2: What is the level of technology acceptance self-reported by the respondents in terms of:**

- Perceived Usefulness (PU);
- Perceived Ease of Use (PEOU);
- Behavioral intention to use;
- Actual use.

**Q3: What is the level of digital citizenship practices self-reported by the respondents in terms of:**

- Digital access;
- Digital communication;
- Digital literacy;
- Digital etiquette;
- Digital law.

**Q4: To what extent do the dimensions of technology acceptance predict the digital citizenship practices of maritime teachers in Cebu City?**

## 4. LITERATURE OVERVIEW

In the 21st century, the integration of digital tools into teaching has become a defining feature of educational innovation, particularly in specialized and practice-oriented fields such as maritime education. As global industries continue to digitize, academic institutions face increasing pressure to modernize instructional delivery to remain relevant and responsive to workforce demands. In maritime education, where simulation-based training, e-navigation systems, safety management, and compliance with international standards are essential, the effective integration of digital technologies is not only a pedagogical necessity but also a professional imperative.

The Technology Acceptance Model (TAM), developed by Davis (1989), remains one of the most widely used theoretical frameworks for explaining individuals' adoption and use of technology in educational settings. TAM posits that perceived usefulness (PU) and perceived ease of use (PEOU) are the primary determinants influencing users' attitudes toward technology, their behavioral intention to use it, and eventual actual use. Empirical studies consistently confirm the robustness of TAM across disciplines and contexts, including higher education and vocational training (Zaineldeen et al., 2020; Marian et al., 2025). In maritime education specifically, recent TAM-based studies reveal that perceived usefulness is the strongest predictor of behavioral intention to adopt emerging technologies, such as virtual reality engine room simulators and social media platforms for instructional purposes (Bacnar et al., 2025; Mohammad et al., 2025). While enjoyment and hedonic motivation may contribute to technology engagement, findings suggest that these factors do not always exert a significant influence on intention to use, particularly in professional maritime contexts, where functionality and performance are prioritized (Mohammad et al., 2025).

Within the Philippine context, the modernization of teaching practices has been identified as a critical concern across all levels of education, including maritime institutions. Padolina-Alcantara (2023) emphasized that digital readiness among maritime teachers plays a vital role in improving instructional effectiveness, while Tanucan et al. (2022) highlighted the importance of institutional support and positive teacher attitudes in facilitating meaningful technology integration. Despite these findings, maritime education remains underrepresented in local literature, creating a gap in understanding how technology acceptance translates into actual instructional practices and professional competencies among maritime teachers.

The COVID-19 pandemic further accelerated digital transformation in education, compelling maritime schools to adopt flexible learning modalities through learning management systems, simulation software, and synchronous online platforms. Studies by Laufer et al. (2021) and Karakose et al. (2021) documented how this abrupt shift reshaped teaching behaviors, fostering adaptability, openness to innovation, and increased reliance on digital tools. These behavioral changes closely align with TAM constructs, reinforcing the relevance of examining technology acceptance as a precursor to sustained digital integration beyond emergency remote teaching.

Beyond technology acceptance, recent literature underscores the growing importance of digital competence and digital citizenship in educational environments. Digital citizenship, defined as the responsible, ethical, safe, and effective use of digital technologies, has been shown to significantly influence learning quality and outcomes. In civic education, digital citizenship accounted for approximately 69% of the variance in learning quality, highlighting its strong explanatory power (Alrahman et al., 2024). Similarly, digital citizenship programs which use blended and game-based learning designs have been found to enhance digital etiquette, motivation, engagement, and digital literacy skills (Erol, 2025; Panjaburee et al., 2024).

In maritime and higher education contexts, maritime teachers generally report high levels of competence in information and data literacy, communication and collaboration, digital content creation, and online safety, yet demonstrate comparatively weaker skills in digital problem-solving (Cabaron, 2024). Studies further reveal that digital competence and self-efficacy significantly shape teachers' technology adoption and actual use of digital tools in maritime colleges (Masuku, 2025). Similar findings have been reported among Chinese seafarers, whose overall digital literacy improved markedly following targeted information technology training programs (Li et al., 2024), underscoring the role of continuous professional development in enhancing digital readiness.

Globally, extended TAM and UTAUT models applied in higher education consistently identify perceived usefulness or performance expectancy as the strongest predictor of behavioral intention to use digital platforms such as mobile learning systems, learning management systems, metaverse environments, and AI-powered tools (Marian et al., 2025). Importantly, for teachers, technology acceptance does not end with tool adoption; rather, it serves as a critical enabling factor for integrating digital tools that support students' development of digital competencies and responsible digital citizenship (Marian et al., 2025). Consequently, technology acceptance and digital citizenship are increasingly viewed as interrelated constructs that collectively contribute to instructional innovation and sustainable digital transformation.

## **5. RESEARCH METHODOLOGY**

### **5.1. Design**

This study used a descriptive-correlational research design, suitable for examining the strength and direction of relationships between variables in a non-experimental setting (Devi et al., 2022). The descriptive component profiled maritime teachers in Cebu City according to their technology acceptance and classroom integration of digital tools. Technology acceptance was measured using the Technology Acceptance Model (TAM) constructs: perceived usefulness,

perceived ease of use, attitude toward use, and behavioral intention. The correlational component analyzed the predictive relationships between these TAM dimensions and digital tool integration using multiple linear regression.

## **5.2. Environment**

This study was conducted in Cebu City, Philippines, a hub for maritime education hosting higher education institutions and maritime training centers. Respondents were maritime teachers teaching general education and specialized courses, including navigation, marine engineering, safety, maritime law, and simulation-based training. This setting is ideal for studying technology integration in maritime education, which requires technical competence and compliance with international standards such as the STCW Convention.

## **5.3. Respondents and Sampling**

The study included 253 maritime teachers from accredited higher education institutions in Cebu City. A power analysis indicated that a minimum of 210 respondents was sufficient to detect medium effect sizes with 80% power at  $\alpha = 0.05$ .

Participants were selected using purposive and voluntary response sampling via online professional networks, primarily Facebook groups. Inclusion criteria required participants to be currently employed as maritime teachers, teach maritime courses, and have experience with digital instructional tools. Limitations of this approach, including potential self-selection bias and limited application to broader populations, are acknowledged.

## **5.4. Instrument**

Data were collected using a structured online questionnaire consisting of two parts:

- Demographics: Age, gender, marital status, years of teaching, teaching load, and technology training exposure.
- Technology Acceptance and Integration Constructs: 36 items measured on a 5-point Likert scale, covering TAM dimensions (perceived usefulness, perceived ease of use, attitude, and behavioral intention) and actual classroom technology integration.

The instrument was validated by experts in educational technology and maritime education, pilot-tested, and demonstrated high internal reliability (Cronbach's  $\alpha = 0.895$ ). Ethical compliance and informed consent were ensured.

## **5.5. Data Gathering Procedure**

The survey was distributed online through Facebook groups and professional networks. Participants meeting inclusion criteria completed the survey voluntarily. Data collection lasted four weeks, with periodic reminders to encourage participation. Data were downloaded, cleaned, and coded for analysis while maintaining confidentiality.

## **5.6. Data Analysis**

Data were analyzed using SPSS version 26. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were computed to summarize the demographic characteristics of the respondents and their responses across the study variables. The internal consistency of the instrument was assessed using Cronbach's alpha, with a reliability coefficient of  $\alpha \geq 0.70$  considered acceptable. Pearson correlation analysis was conducted to examine the relationships among the Technology Acceptance Model (TAM) constructs and digital tool integration. The predictive effects of the TAM dimensions on technology integration were determined using multiple linear regression, with the coefficient of determination ( $R^2$ ), standardized beta coefficients, and significance levels ( $p < 0.05$ ) reported. Prior to conducting the regression analysis, the assumptions of linearity, normality, multicollinearity, and homoscedasticity were checked to ensure result validity and robustness.

## 6. RESULT AND DISCUSSION

**Q1: What is the demographic profile of maritime teacher respondents in terms of:**

- Age;
- Sex;
- Marital status;
- Highest educational attainment;
- Years in school teaching.

	Frequency	Percent	Valid percent	Cumulative percent
25-30	62	24.5	24.5	24.5
30-35	97	38.3	38.3	62.8
35-40	57	22.5	22.5	85.4
40 and above	37	14.6	14.6	100.0
Total	253	100.0	100.0	

Table 1. Age

The age distribution of the 253 maritime teachers indicates a relatively youthful workforce in Cebu City. The majority (38.3%) are 30–35 years old, followed by 24.5% in the 25–30 age group. This predominance of early- to mid-career maritime teachers may contribute positively to the adoption of digital tools, as younger teachers tend to be more adaptable to technological innovations and digital teaching practices. These findings align with the notion that maritime teachers at the beginning of their careers are more likely to engage with emerging educational technologies and integrate them into simulator-based and e-navigation training contexts.

	Frequency	Percent	Valid Percent	Cumulative Percent
Female	126	49.8	49.8	49.8
Male	127	50.2	50.2	100.0
Total	253	100.0	100.0	

Table 2. Gender

The gender distribution of the 253 maritime teachers surveyed in Cebu City is nearly balanced, with 50.2% ( $n = 127$ ) identifying as male and 49.8% ( $n = 126$ ) as female. This parity indicates that both genders are equally represented in the maritime education workforce within the city, reflecting a shift toward greater inclusivity in a traditionally male-dominated field. Such balance may also foster a diversity of pedagogical perspectives and influence attitudes toward the adoption and integration of digital tools, potentially enriching the study’s analysis of technology acceptance across gender lines. Moreover, the near equal representation of male and female teachers enhances the applicability of the findings to similar contexts, particularly in assessing variations, if any, in technology-related practices and perceptions across gender.

	Frequency	Percent	Valid Percent	Cumulative Percent
Married	118	46.6	46.6	46.6
Single	135	53.4	53.4	100.0
Total	253	100.0	100.0	

Table 3. Marital status

The marital status of the 253 maritime teachers surveyed reveals a slightly higher proportion of single respondents, with 53.4% ( $n = 135$ ) identifying as single, and 46.6% ( $n = 118$ ) as married. This distribution indicates that the majority of the maritime teaching workforce in Cebu City is currently unmarried, which may have implications for their flexibility, availability, and adaptability in adopting and integrating digital tools in their teaching practices. Single maritime teachers, potentially having fewer familial responsibilities, may have more time and willingness to engage with technological innovations and professional development activities. Nevertheless, the substantial proportion of married respondents adds diversity to the

study, allowing for a more nuanced understanding of how marital status may intersect with technology acceptance and instruction practices in maritime education.

	Frequency	Percent	Valid percent	Cumulative percent
Bachelors degree	69	27.3	27.3	27.3
Doctoral degree	49	19.4	19.4	46.6
Masters degree	135	53.4	53.4	100.0
Total	253	100.0	100.0	

Table 4. Highest educational attainment

The highest educational attainment of the 253 maritime teachers surveyed reflects a highly qualified teaching workforce, with the majority holding advanced degrees. More than half of the respondents, or 53.4% (n = 135), reported having attained a master’s degree, indicating a strong presence of graduate-level education among maritime teachers in maritime institutions across Cebu City. Additionally, 19.4% (n = 49) of the participants hold doctoral degrees, further reflecting a commendable level of academic and professional advancement within the sector. Meanwhile, 27.3% (n = 69) of the respondents have completed a bachelor’s degree as their highest level of education. This distribution highlights the emphasis placed on continuous education and specialized knowledge in maritime higher education, a field that increasingly demands both teaching competence and technical expertise. The prevalence of postgraduate degree holders suggests a strong potential for adopting and integrating digital tools, as maritime teachers with higher educational attainment are often more engaged in scholarly activities, professional training, and instructional innovation. These findings provide critical context for understanding how educational qualifications may shape attitudes and behaviors toward technology acceptance in maritime teaching practices.

	Frequency	Percent	Valid percent	Cumulative percent
1 -5 years	79	31.2	31.2	31.2
10-20 years	61	24.1	24.1	55.3
5-10 years	83	32.8	32.8	88.1
More than 20 years	30	11.9	11.9	100.0
Total	253	100.0	100.0	

Table 5. Years in school teaching

The distribution of teaching experience among the 253 maritime teachers in this study reflects a diverse range of professional tenure within the academic sector. The largest group of respondents, 32.8% (n = 83), reported 5 to 10 years of teaching experience, closely followed by 31.2% (n = 79) with 1 to 5 years. Those with 10 to 20 years of service comprise 24.1% (n = 61), while teachers with over 20 years of teaching experience make up the smallest group at 11.9% (n = 30). This distribution suggests that a significant portion of the maritime teaching workforce in Cebu City consists of early- to mid-career professionals who are relatively seasoned, yet not nearing retirement. The predominance of maritime teachers within the 1–10-year range suggests a teaching population that is likely to be more open to change, receptive to technological advancements, and actively engaged in pedagogical development. At the same time, the presence of a substantial number of long-serving maritime teachers contributes institutional knowledge and depth to instruction practices. This diversity in experience provides a valuable context for examining how years of teaching affect technology acceptance and the integration of digital tools in maritime education.

**Q2: What is the level of technology acceptance self-reported by the respondents in terms of:**

- Perceived Usefulness (PU);
- Perceived Ease of Use (PEOU);
- Behavioral intention to use;
- Actual use.

	NN	Minimum	Maximum	Mean	Std. deviation
Overall mean perceived usefulness	253	3.00	5.00	4.0366	.33392
Overall mean ease of use	253	3.25	5.00	4.0326	.31603
Overall mean behavioral intention	253	3.25	5.00	4.0059	.31960
Overall mean actual use	253	3.25	5.00	4.0069	.32229
Valid N (list-wise)	253	3.19	5.00	4.015	0.32296

Table 6. Level of technology acceptance

The descriptive statistics for the core constructs derived from the Technology Acceptance Model (TAM) indicate generally high levels of technology acceptance and digital tool integration among maritime teachers in Cebu City. Among the 253 respondents, mean scores for all TAM dimensions were well above the midpoint of the five-point Likert scale, reflecting favorable perceptions, strong intentions, and consistent engagement with digital technologies in instructional practice. This pattern suggests that maritime teachers in this context are not only receptive to educational technologies but are also actively incorporating them into their teaching, aligning with the demands of 21st-century maritime education.

Among the TAM constructs, Perceived Usefulness had the highest mean score ( $M = 4.0366$ ,  $SD = 0.33392$ ), indicating that respondents strongly believe digital technologies enhance teaching effectiveness, instructional efficiency, and learning outcomes. This finding supports Davis’s (1989) assertion that perceived usefulness is a central driver of technology acceptance and is consistent with recent maritime-specific studies identifying perceived usefulness as the strongest predictor of intention to use emerging instructional tools such as simulation technologies and digital learning platforms (Bacnar et al., 2025; Mohammad et al., 2025). In professional and competency-based disciplines like maritime education, where accuracy, realism, and performance are critical, teachers’ emphasis on functional value over novelty further explains the prominence of this construct.

Closely aligned with perceived usefulness is Perceived Ease of Use ( $M = 4.0326$ ,  $SD = 0.31603$ ), indicating that maritime teachers generally find digital tools manageable and user-friendly in teaching contexts. This finding supports earlier research showing that ease of use reduces cognitive and operational barriers to technology integration, especially in technologically intensive environments (Zaineldeen et al., 2020). The relatively low variability in responses suggests that respondents have similar experiences in navigating learning management systems, simulation software, and other digital tools, possibly reflecting increased exposure and institutional support following the digital shift prompted by the COVID-19 pandemic (Laufer et al., 2021; Karakose et al., 2021).

The high mean scores for Behavioral Intention to Use Technology ( $M = 4.0059$ ,  $SD = 0.31960$ ) and Actual Use of Technology ( $M = 4.0069$ ,  $SD = 0.32229$ ) further demonstrate that favorable perceptions of digital tools translate into both strong intention and actual classroom application. This alignment between intention and use is consistent with extended TAM and UTAUT findings in higher education, which emphasize that when perceived usefulness and ease of use are high, behavioral intention reliably leads to sustained technology utilization (Marian et al., 2025). In the context of maritime education, this suggests that teachers are not merely complying with institutional directives but are actively engaging with digital tools as part of their teaching practice.

The overall mean across all TAM constructs ( $M = 4.015$ ,  $SD = 0.32296$ ), along with consistently low standard deviations, suggests a shared and stable disposition toward technology integration among maritime teachers in Cebu City. This homogeneity may be attributed to the standardized nature of maritime training, shared regulatory requirements, and common exposure to digital systems used in navigation, safety, and simulation-based instruction. These findings are consistent with Cabaron (2024), who reported high levels of digital competence among maritime teachers, particularly in information literacy, communication, and digital content creation, while also emphasizing the role of professional context in shaping technology-related attitudes.

From a broader perspective, the high levels of technology acceptance observed in this study provide a critical foundation for understanding how digital tool integration may support the development of digital competencies and digital citizenship within maritime education. Prior studies suggest that maritime teachers’ acceptance and effective use of

technology are essential for fostering students' responsible, ethical, and competent engagement with digital environments (Marian et al., 2025; Alrahman et al., 2024). Thus, the positive disposition toward technology among maritime teachers positions them as key agents in promoting not only instructional innovation but also the cultivation of digital citizenship aligned with global maritime and educational standards.

**Q3: What is the level of digital citizenship practices self-reported by the respondents in terms of:**

- Digital access;
- Digital communication;
- Digital literacy;
- Digital etiquette;
- Digital law.

	N	Minimum	Maximum	Mean	Std. deviation
Overall mean digital access	253	3.25	5.00	4.0366	.30439
Overall mean digital communication	253	3.00	5.00	4.0148	.31344
Overall mean digital	253	3.00	5.00	4.0148	.31344
Overall mean digital literacy	253	3.00	5.00	4.0247	.30721
Overall mean digital etiquette	253	3.25	5.00	4.0217	.30378
Overall mean digital law	253	3.25	5.00	4.0089	.31759
Valid N (listwise)	253				

Table 7. Level of digital citizenship practices

The descriptive statistics for the digital citizenship dimensions among maritime teachers in Cebu City reveal a consistently high level of self-reported competence across multiple aspects of responsible, ethical, and effective digital engagement. All six constructs yielded mean scores exceeding 4.00 on a five-point Likert scale, indicating a strong overall orientation toward digital responsibility and awareness. These findings suggest that maritime teachers possess the foundational competencies required to navigate digital environments in ways that enhance both instructional effectiveness and professional accountability.

Among the six dimensions, Digital Access recorded the highest mean score ( $M = 4.0366$ ,  $SD = 0.30439$ ), indicating that respondents generally have sufficient and equitable access to digital tools, platforms, and connectivity required for teaching. This finding is consistent with post-pandemic literature highlighting improvements in institutional digital infrastructure and the increasing normalization of technology integration in higher education, particularly in professionally regulated fields such as maritime education (Padolina-Alcantara, 2023; Karakose et al., 2021). Adequate digital access is a critical enabling condition for technology integration and is a prerequisite for the development of more advanced digital competencies.

Digital Literacy also obtained a high mean score ( $M = 4.0247$ ,  $SD = 0.30721$ ), reflecting respondents' strong confidence in their ability to locate, evaluate, and apply digital content in pedagogically meaningful ways. This result supports findings by Cabaron (2024), who reported that maritime teachers demonstrate high levels of information and data literacy, as well as competencies in communication, and content creation. In the context of maritime education, where accuracy, compliance, and technical precision are paramount, strong digital literacy is vital for ensuring the quality and credibility of instructional materials.

Similarly, Digital Etiquette ( $M = 4.0217$ ,  $SD = 0.30378$ ) and Digital Communication ( $M = 4.0148$ ,  $SD = 0.31344$ ) both yielded high mean scores, indicating that maritime teachers generally demonstrate appropriate online behavior and maintain constructive interactions within digital learning environments. These findings echo studies demonstrating that digital citizenship initiatives and blended learning environments enhance ethical awareness, respectful communication, and engagement among both educators and learners (Erol, 2025; Panjaburee et al., 2024). Such competencies are essential in fostering safe and professional online learning spaces, particularly within virtual and simulation-based maritime instruction.

Although Digital Law recorded the lowest mean score among the six dimensions ( $M = 4.0089$ ,  $SD = 0.31759$ ), it remains within a high range, suggesting substantial awareness of legal and ethical responsibilities related to copyright, data privacy, and cyber ethics. Nevertheless, the relatively lower score suggests a potential area for further professional development, as compliance with international maritime regulations increasingly intersects with digital data management, cybersecurity, and intellectual property considerations. This pattern is consistent with prior research indicating that while

educators tend to exhibit confidence in functional digital skills, more complex legal and regulatory aspects of digital citizenship require sustained training and institutional support (Li et al., 2024).

Furthermore, the consistently low standard deviations across all digital citizenship dimensions suggest a relatively homogeneous set of responses, pointing to a shared digital culture or similar training experiences among the respondents. This uniformity may be attributed to standardized maritime curricula, regulatory frameworks, and common exposure to digital systems used in navigation, safety protocols, and instructional delivery. Moreover, high levels of digital citizenship observed among teachers are particularly noteworthy, as existing literature has established strong correlation between educators' digital citizenship practices and improved learning quality, engagement, and ethical technology use among students (Alrahman et al., 2024; Marian et al., 2025).

**Q4: To what extent do the dimensions of technology acceptance predict the digital citizenship practices of maritime teachers in Cebu City?**

Model	R	R square	Adjusted R square	Std. error of the estimate
1	.262 <sup>a</sup>	.069	.022	.43361
Predictors: (Constant), Overall Mean Perceived Usefulness, Overall Mean Perceived Ease of Use, Overall Mean Behavioral Intention to Use, Overall Mean Actual Use				

Table 8. Model summary

Table 8 presents the model summary of the multiple linear regression analysis examining the extent to which the dimensions of technology acceptance predict the digital citizenship practices of maritime teachers in Cebu City. The regression model yielded a correlation coefficient (R = .262), indicating a positive but weak overall relationship between the technology acceptance variables and digital citizenship practices. This suggests that while technology acceptance is related to digital citizenship, the association is modest in magnitude.

The coefficient of determination ( $R^2 = .069$ ) shows that approximately 6.9% of the variance in digital citizenship practices can be explained by the combined effects of perceived usefulness, perceived ease of use, behavioral intention to use, and actual use of technology. After adjusting for the number of predictors in the model, the adjusted  $R^2$  decreased to .022, reflecting limited explanatory power once potential inflation due to multiple predictors is controlled. Although the proportion of explained variance is relatively small, this result remains theoretically meaningful, particularly given the multifaceted and value-laden nature of digital citizenship.

The modest explanatory power of the model aligns with existing literature suggesting that digital citizenship extends beyond technology acceptance and usage. While prior studies have established that teachers' technology acceptance is essential for integrating digital tools that facilitate digital competence and ethical engagement (Marian et al., 2025), digital citizenship behaviors are also shaped by broader contextual and institutional influences. Research indicates that factors such as institutional policies, professional norms, ethical training, and structured digital citizenship programs substantially affect responsible digital behavior (Alrahman et al., 2024; Panjaburee et al., 2024).

In maritime education, digital citizenship is further shaped by regulatory compliance requirements, safety-oriented professional ethics, and exposure to standardized training protocols established by national and international maritime authorities. These contextual factors may limit the extent to which individual perceptions of technology usefulness or ease of use directly translate into observable digital citizenship practices. Cabaron (2024) and Li et al. (2024) similarly found that although maritime teachers and seafarers demonstrate high levels of functional digital competence, more complex ethical and legal aspects of digital behavior are influenced by formal training and institutional culture rather than personal technology acceptance alone. The standard error of the estimate (.43361) indicates moderate dispersion between observed and predicted digital citizenship scores, further reinforcing the presence of substantial unexplained variance in the model. This finding highlights the complexity of digital citizenship as a behavioral construct that includes ethical judgment, legal awareness, and professional responsibility dimensions that may not be fully captured by technology acceptance frameworks such as TAM.

	Model	Sum of squares	df	Mean square	F	Sig.
1	Regression	1.099	4	.275	1.461	.222 <sup>b</sup>
	Residual	14.853	79	.188		
	Total	15.952	83			

a. Dependent variable: Overall mean digital access  
b. Predictors: (Constant overall mean perceived usefulness, overall mean perceived ease of use, overall mean behavioral intention to use, overall mean actual use)

Table 9. ANOVA

Table 9 presents the ANOVA results examining the predictive power of technology acceptance dimensions on the digital access component of digital citizenship among maritime teachers in Cebu City. The regression model yielded an F value of 1.461 with a significance level of  $p = .222$ , indicating that the model did not significantly predict digital access. This result suggests that variations in digital access among respondents are not adequately explained by individual perceptions, attitudes, or usage intentions toward technology as conceptualized within the Technology Acceptance Model (TAM).

The non-significant finding may be partly attributed to the limited variability observed in digital access responses, as reflected by consistently high mean scores (approximately 4.0) and relatively low standard deviations (around 0.3). This pattern suggests a possible ceiling effect, where respondents already perceive digital access to be uniformly high, thereby constraining the statistical model's ability to detect meaningful differences. Additionally, self-reported measures of access may be susceptible to social desirability bias, particularly in professional contexts where digital competence and readiness are institutionally expected.

More substantively, the findings align with existing literature emphasizing that digital access is predominantly shaped by institutional and structural factors rather than individual-level technology acceptance. Studies in the Philippine educational context have consistently highlighted the role of organizational support, infrastructure availability, administrative policies, and funding priorities in determining teachers' access to digital tools and platforms (Padolina-Alcantara, 2023; Tanucan et al., 2022; Lin, 2024). In maritime education, this structural influence is even more pronounced, as access to digital resources is closely tied to specialized and capital-intensive infrastructure such as bridge and engine room simulators, e-navigation systems, and regulated learning platforms required to meet STCW competencies and International Maritime Organization (IMO) standards.

This institutional dependency sets maritime teachers apart from those in general education, where digital access is often shaped by individual initiative or classroom-level decisions. By contrast, the practical use of digital technologies in maritime training is highly regulated, standardized, and reliant on institutional provision, which limits the extent to which personal technology acceptance can directly affect access.

The non-significant result can also be interpreted within the broader context of the COVID-19 pandemic, which accelerated digital transformation throughout Philippine education systems. While studies by Laufer et al. (2021) and Karakose et al. (2021) documented increased teacher adaptability and openness to technology, they also identified ongoing systemic constraints related to infrastructure and connectivity. These findings support the current study's conclusion that digital access often precedes individual technology acceptance; without adequate institutional support and specialized maritime infrastructure, teachers' positive attitudes and intentions toward technology may have limited effect on their actual access to digital resources.

Finally, the results highlight the complexity of defining digital citizenship within maritime education. Beyond general digital citizenship frameworks, digital access in maritime contexts must include competencies related to maritime cybersecurity, secure operation of Electronic Chart Display and Information Systems (ECDIS), and ethical digital navigation practices. These competencies are governed by international regulations and safety standards, reinforcing the notion that digital access in maritime education is as much an organizational and regulatory matter as it is an individual behavioral one.

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. error	Beta		
(Constant)	2.675	.800		3.344	.001
Overall mean perceived usefulness	.055	.112	.056	.490	.626
Overall Mean Perceived Ease of Use	-.068	.117	-.065	-.588	.559
Overall Mean Behavioral Intention to Use	.102	.126	.091	.812	.419
Overall mean actual use	.247	.130	.210	1.890	.062

a. Dependent variable: Overall mean digital access

Table 10. Coefficients

Table 10 presents the regression coefficients examining the predictive effects of the Technology Acceptance Model (TAM) dimensions on the digital access component of digital citizenship among maritime teachers in Cebu City. The model included perceived usefulness, perceived ease of use, behavioral intention to use, and actual use of technology as predictors, with digital access as the dependent variable. The results indicate that none of the TAM dimensions reached conventional statistical significance at  $p < .05$ . Specifically, perceived usefulness ( $\beta = .056$ ,  $p = .626$ ), perceived ease of use ( $\beta = -.065$ ,  $p = .559$ ), and behavioral intention ( $\beta = .091$ ,  $p = .419$ ) showed negligible predictive effects on digital access.

Notably, actual use of technology approached marginal significance ( $\beta = .210$ ,  $p = .062$ ), suggesting that hands-on engagement with digital tools may have a limited but observable influence on teachers' digital access practices. This finding aligns with prior research emphasizing that active interaction with technology strengthens both competency and responsible digital behavior (Masuku, 2025; Panjaburee et al., 2024). In maritime education, such practical engagement includes operating simulators, e-navigation systems, and other specialized digital platforms, as well as adhering to maritime cybersecurity and ethical navigation standards.

Two factors likely influence the overall lack of statistically significant predictive power for TAM constructs. First, the consistently high mean scores across all variables ( $M \approx 4.0$ ,  $SD \approx 0.3$ ) suggest potential ceiling effects or social desirability bias, which limit the observable variation necessary for strong predictive relationships. Second, these results indicate that digital access in maritime education is heavily mediated by institutional and structural determinants, rather than individual perceptions or attitudes alone. Studies in the Philippine and international maritime context have shown that access to specialized tools such as bridge and engine room simulators, electronic charting systems (ECDIS), and secure digital platforms is contingent on adequate institutional provisioning, administrative support, connectivity, and compliance with STCW competencies and International Maritime Organization (IMO) standards (Padolina-Alcantara, 2023; Tanucan et al., 2022; Lin, 2024).

The near-significant contribution of actual use highlights an important nuance: while attitudes and intentions alone are insufficient to ensure digital access, active utilization of technology can enhance engagement and partially overcome structural limitations. This suggests that hands-on exposure to maritime-specific digital tools may serve as a critical lever for operationalizing digital citizenship, complementing both institutional support and individual technology acceptance.

Collectively, these findings underscore the multifaceted nature of digital citizenship within the context of maritime education. Unlike general educational settings—where technology acceptance variables often directly predict digital engagement—maritime teachers' access to and responsible use of digital tools appear to be shaped by an interplay of individual engagement, regulatory mandates, and specialized institutional infrastructure. This complexity highlights the need to integrate hands-on training, adequate institutional provisioning, and clearly articulated ethical guidelines into professional development initiatives. Such an integrated approach is essential not only for promoting technology adoption but also for cultivating responsible and context-sensitive digital citizenship practices.

Table 10 presents the regression coefficients examining the predictive effects of the dimensions of technology acceptance on the digital access component of digital citizenship among maritime teachers in Cebu City. The model included perceived usefulness, perceived ease of use, behavioral intention to use, and actual use of technology as predictor variables, with digital access serving as the dependent variable.

The unstandardized and standardized coefficients reveal that none of the TAM dimensions were statistically significant predictors of digital access at the conventional  $p < .05$  threshold. Specifically, perceived usefulness ( $\beta = .056$ ,  $p = .626$ ), perceived ease of use ( $\beta = -.065$ ,  $p = .559$ ), and behavioral intention ( $\beta = .091$ ,  $p = .419$ ) had negligible predictive effects. However, actual use approached marginal significance ( $\beta = .210$ ,  $p = .062$ ), suggesting that maritime teachers'

hands-on engagement with technology may have a limited but observable influence on their digital access practices. The consistently high mean scores ( $M \approx 4.0$ ,  $SD \approx 0.3$ ) indicate potential ceiling effects or social desirability bias, which may have minimized variation and reduced the apparent predictive power of the TAM dimensions.

These results suggest that digital access among maritime teachers is minimally shaped by individual perceptions and attitudes toward technology alone. In maritime education, the integration of digital tools is heavily mediated by institutional and structural factors, such as the availability of simulators, e-navigation systems, internet connectivity, and administrative support, which are necessary to comply with STCW competencies and IMO digital standards (Padolina-Alcantara, 2023; Tanucan et al., 2022; Lin, 2024). Therefore, even teachers with positive attitudes toward technology and high perceived usefulness may face barriers to actual access if specialized infrastructure is insufficient or limited.

The near-significant contribution of actual use ( $\beta = .210$ ,  $p = .062$ ) reinforces the importance of practical, hands-on engagement in operationalizing digital citizenship. In maritime contexts, this includes active use of simulators, digital navigation tools like ECDIS, and adherence to digital navigation ethics and maritime cybersecurity practices. These findings suggest that, beyond general TAM constructs, the opportunity to directly interact with maritime-specific technology is a critical determinant of digital access and responsible digital behavior among maritime teachers.

## 7. CONCLUSION

The rapid advancement of digital technologies has transformed educational practices, compelling maritime teachers to integrate tools such as simulators, e-navigation systems, and digital platforms into instruction. Guided by the Technology Acceptance Model (TAM; Davis, 1989), this study examined the relationship between technology acceptance - encompassing perceived usefulness, perceived ease of use, behavioral intention, and actual use - and digital citizenship practices among 253 maritime teachers in Cebu City. Respondents were predominantly early- to mid-career, highly educated, and adaptable, suggesting a workforce generally receptive to technological innovations.

Findings revealed high levels of technology acceptance and digital citizenship, with mean scores consistently exceeding 4.0 across all constructs. These results reflect a strong orientation towards effective, ethical, and responsible use of digital tools in maritime teaching. However, multiple linear regression analysis indicated that TAM dimensions only modestly predicted digital citizenship ( $R^2 = .069$ ), with actual use approaching significance. This suggests that attitudes and intentions alone are insufficient to fully account for responsible digital practices; contextual factors such as access to specialized infrastructure, hands-on engagement with maritime-specific tools, institutional policies, and professional ethics play critical roles.

These findings further indicate that practical experience and institutional support are essential for translating technology acceptance into responsible digital behavior. Effective professional development and policy interventions should therefore combine attitudinal training with opportunities for hands-on application and reinforcement of ethical standards. By addressing both behavioral and structural factors, maritime educators can be better equipped to meet the demands of 21<sup>st</sup> century teaching while upholding global standards for safe and responsible digital practice.

## 8. RECOMMENDATIONS

Based on these findings, professional development programs for maritime teachers should prioritize hands-on training with maritime-specific digital tools. Such initiatives should extend beyond operational proficiency to address the ethical and legal aspects of digital citizenship. Institutions should ensure equitable access to specialized infrastructure, including simulators, e-navigation systems, and secure digital platforms, while providing administrative and technical support to facilitate responsible technology use. Policies should integrate digital citizenship competencies into teacher training and performance evaluation frameworks to reinforce professional norms and ethical behavior. Finally, future research should explore additional predictors of digital citizenship, such as organizational culture, digital ethics education, and professional standards, and conduct longitudinal studies to examine the long-term impact of technology adoption on responsible digital behavior in maritime education.

## CONFLICT OF INTEREST

The author declares no conflict of interest. This research was conducted independently and was not influenced by any personal, financial, or institutional interests that could have inappropriately affected the objectivity, integrity, or outcomes of the study.

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