

Students' and Graduates' Perceptions of the Relevance of the Maritime Education and Training (MET) Mathematics Curriculum to Their Studies and Future Careers

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Abstract: Curriculum relevance remains a central concern in engineering and professionally oriented higher education, particularly within Maritime Education and Training (MET), where graduates are expected to meet both academic standards and the operational demands of the global maritime industry. Mathematics plays a foundational role in marine engineering education, underpinning navigation, propulsion systems, stability analysis, thermodynamics, electrical systems, and operational decision-making. Despite its recognized importance, students and graduates frequently question the relevance of mathematics to their studies and future careers, especially when mathematical instruction appears abstract or weakly connected to maritime practice. This study examines students' and graduates' perceptions of the relevance of the MET mathematics curriculum, using the Marine Engineering programme at the Regional Maritime University (RMU), Ghana, as a case study. Grounded in curriculum relevance theory, expectancy-value theory, and employability discourse, the study synthesizes empirical insights from students and graduates and situates the findings within broader international debates on mathematics and engineering education. The findings indicate that while the MET mathematics curriculum is widely perceived as relevant for academic progression and conceptual understanding, its relevance to professional maritime practice is less visible to learners, particularly during training. Graduates, however, tend to retrospectively acknowledge the indirect and enabling role of mathematics in professional competence and adaptability. The study argues that enhancing curriculum relevance requires deliberate contextualization, pedagogical integration, and closer alignment of mathematical learning with maritime career pathways and industry practices.

Keywords: MET mathematics, curriculum relevance, marine engineering education, graduate perceptions, Ghana.

1. INTRODUCTION

Mathematics is universally acknowledged as a core discipline underpinning scientific inquiry, engineering practice, and technological advancement. Across engineering disciplines, mathematical competence supports analytical reasoning, modelling, problem-solving, and decision-making. In Maritime Education and Training (MET), mathematics occupies a particularly critical position, as marine engineers are required to operate, maintain, and manage complex mechanical, electrical, and electronic systems in dynamic and high-risk environments. Competence in mathematics underpins areas such as ship stability, propulsion efficiency, thermodynamic cycles, fluid mechanics, electrical power systems, and control engineering. Despite this centrality, persistent concerns have emerged regarding students' and graduates' perceptions of the relevance of mathematics curricula in engineering education. In MET institutions, these concerns are amplified by the professional and regulatory nature of maritime programmes, where students often expect a strong and visible link between what they learn in the classroom and what they will do at sea or in shore-based maritime roles. When mathematics is presented in a highly abstract or decontextualized manner, students may struggle to see its value beyond passing examinations, leading to reduced motivation and engagement.

In professionally oriented programmes such as marine engineering, learners frequently evaluate curriculum relevance through the lens of employability, practical application, and career readiness. Mathematics, when taught as a stand-alone theoretical subject without an explicit maritime context, may be perceived as an academic hurdle rather than a professional enabler. This perception persists even when mathematics provides the cognitive foundation for understanding engineering science and technological systems.

1.1 Problem Statement

RMU occupies a strategic position in West African maritime education and operates within international regulatory frameworks such as the International Maritime Organization's Standards of Training, Certification and Watchkeeping (STCW) Convention. Understanding how learners and graduates perceive mathematics relevance in this context is therefore significant not only for institutional curriculum improvement but also for broader debates on MET curriculum reform in developing maritime nations. This study investigates students' and graduates' perceptions of the relevance of the MET mathematics curriculum to their academic studies and future careers, focusing on the Marine Engineering programme at the Regional Maritime University (RMU), Ghana.

1.2 Objectives of the study

The following specific objectives guided the study:

- (i) To examine students' and graduates' perceptions of the relevance of the Maritime Education and Training (MET) Mathematics Curriculum to their academic studies.
- (ii) To assess the extent to which the Maritime Education and Training (MET) Mathematics Curriculum aligns with the practical skills requirements of the maritime professions.
- (iii) To identify gaps and areas for improvement in the Maritime Education and Training (MET) Mathematics Curriculum based on the students' and graduates' experiences.

1.3 Research questions

- (i) How do students' and graduates' perceive the relevance of the maritime education and training (MET) mathematics curriculum to their academic studies?
- (ii) To what extent do the Maritime Education and Training (MET) Mathematics Curriculum align with the practical skills requirements of the maritime professions?
- (iii) What gaps or areas for improvement do students and graduates identify in the Maritime Education and Training (MET) Mathematics Curriculum regarding its relevance to their studies and future careers?

1.4 Significance

By foregrounding student and graduate perspectives, this study contributes to empirical scholarship on curriculum relevance, mathematics education, and employability within maritime higher education. It also responds to calls for evidence-based curriculum evaluation that integrates academic, professional, and student-centered considerations.

2. LITERATURE REVIEW

2.1 Conceptual review: Curriculum Relevance in MET Mathematics

Curriculum relevance is a multifaceted concept that refers to the extent to which curriculum content, pedagogy, and assessment align with learners' academic needs, societal expectations, and professional requirements (van den Akker, 2003). In higher education, relevance is increasingly linked to employability, lifelong learning, and responsiveness to industry needs, particularly in professionally oriented disciplines such as engineering and maritime studies.

In engineering education, curriculum relevance is commonly examined across two interrelated dimensions: academic relevance and vocational relevance. Academic relevance refers to the extent to which curriculum content supports intellectual development, conceptual understanding, cognitive skills, and progression within an academic programme. Vocational relevance, by contrast, emphasizes the applicability of learning to workplace practices, professional competence,

and career advancement (Bok, 2006). Within MET mathematics, relevance is further shaped by learners' perceptions of usefulness, confidence, and career alignment. Mathematics relevance is, therefore, not only a curricular issue but also a psychological and motivational construct.

Expectancy–value theory provides a useful lens for understanding how students evaluate mathematics. According to Eccles and Wigfield (2002), learners' engagement and persistence in a subject are influenced by their expectations of success and the value they attach to the subject. When students perceive mathematics as essential for academic success but irrelevant to professional practice, their valuation becomes conditional and instrumental. In addition, employability discourse in higher education emphasizes the development of transferable skills such as problem-solving, analytical thinking, and adaptability. Mathematics contributes significantly to these attributes, even when its application is not immediately visible in professional contexts. However, if this contribution is not made explicit within the curriculum, learners may undervalue mathematics despite its long-term benefits.

2.2 Mathematics and Marine Engineering Education

Marine engineering relies extensively on mathematical principles to support the analysis, design, operation, and maintenance of shipboard systems. Core areas such as thermodynamics, fluid mechanics, strength of materials, electrical engineering, and control systems are all mathematically grounded. Mathematical competence enables marine engineers to interpret technical data, evaluate system performance, diagnose faults, and make informed decisions under operational constraints. At the same time, contemporary maritime practice has undergone a significant technological transformation. Automation, digital monitoring systems, simulation tools, and computer-based diagnostics have reduced the need for manual calculations in day-to-day operations. As a result, the explicit use of advanced mathematical techniques may be less visible to students during sea training and early professional experiences. This can create the impression that mathematics is peripheral rather than central to maritime work. This invisibility of mathematics in practice does not diminish its importance; rather, it highlights its embedded role within technologies and systems. Mathematical understanding enables engineers to interpret outputs, assess system limitations, and respond effectively to abnormal conditions. Without this foundational knowledge, reliance on automated systems can become risky, particularly in emergencies. The disconnect between mathematical foundations and visible workplace application contributes significantly to students' and graduates' perceptions of limited vocational relevance. Addressing this disconnect requires pedagogical strategies that reveal the hidden role of mathematics in maritime technologies and operational decision-making.

2.3 Students' Perceptions of Academic Relevance

Students enrolled in the Marine Engineering programme at RMU generally perceive the MET mathematics curriculum as academically relevant. Mathematics is widely recognized as essential for understanding engineering science courses such as thermodynamics, mechanics, electrical engineering, and naval architecture. Students acknowledge that mathematical competence supports their ability to follow lectures, solve engineering problems, and perform well in assessments.

Specifically, students associate mathematics with:

- a) Understanding engineering principles and models
- b) Developing analytical, logical, and quantitative reasoning
- c) Meeting programme requirements and progressing academically

These perceptions align closely with expectancy–value theory, which suggests that learners value subjects they perceive as instrumental to academic success (Eccles & Wigfield, 2002). Mathematics is, therefore, viewed as a “gateway” subject that enables academic progression. Despite recognizing its academic importance, many students report difficulty in connecting mathematical concepts to real maritime applications, particularly during the early years of study. Mathematics courses are often delivered before students have sufficient exposure to marine engineering systems, making it challenging to contextualize abstract concepts. As a result, students may adopt a surface learning approach focused on passing examinations rather than developing deep conceptual understanding. This finding suggests that academic relevance alone is insufficient to sustain motivation and engagement. Without clear links to maritime practice, students may struggle to internalize the long-term value of mathematics.

2.4 Students' Perceptions about Curriculum Relevance

Throughout the history of higher education in America, various stakeholders have scrutinized the curricula of colleges and universities in an attempt to ensure that a college education remains relevant to their interests (Bok, 2006; Shapiro, 2005). The report titled "A Test of Leadership: Charting the Future of U.S. Higher Education," put forth by the Commission on the Future of Higher Education (2006), serves as an example of this scrutiny. In this report, the federal government explicitly advanced the notion that a relevant post-secondary academic curriculum prepares graduates with skills necessary to enter into a 21st-century workforce and maintain the global economic fortitude of the nation. Colleges and universities also have well-documented statements that outline specific qualities of an academically-relevant curriculum. For example, the Association of American Colleges and Universities (2010) suggested that an academically relevant curriculum is grounded in the ideals of a liberal education (i.e., it facilitates social responsibility, civic leadership, and ethical fortitude), which are needed to maintain an effective democracy.

However, while college students are most directly affected by the curricula of colleges and universities, literature reporting college students' perceptions of the relevance of their academic experience is sparse. The small body of research that has examined academic relevance from students' perspectives was conducted in the 1960's and 1970's. During that time, post-secondary enrollments swelled with an increasingly diverse student population that demanded coursework that was relevant to their past experiences and future aspirations (Bok, 2006).

A 1971 Carnegie Commission Survey highlighted students' concerns; 91 percent of the 70,000 students surveyed wanted their academic coursework to be more relevant to contemporary life and current social problems (Trow, 1971). In light of this report, two empirical studies were conducted that examined the underlying factor structure of academic relevance to better understand the concept and develop a measurable construct for psychometric investigation (Menges & Trumpeter, 1972; Permut, 1974). These studies suggested that academic relevance is a multidimensional concept with the most well-defined dimensions being *applicability* and *usefulness*. That is, when students seek relevance in their academic work, they are most concerned with whether they can directly apply the knowledge and learning resulting from this work to address their personal concerns, as well as social issues they deem important. No follow-up studies examining the relevance of academic work as a distinct construct have since been conducted.

As the idealism and activism prominent on campuses simmered during the 1970's and economic concerns emerged as a focal issue in the early 1980's, academic relevance became synonymous with the practical vocational value of college coursework. A prominent strand of research examined students' perceptions of the usefulness of their academic work as a predictor of persistence (Bean, 1983; Terenzini & Pascarella, 1977). The results of several studies suggested that students' perceptions of their academic experience as relevant to future employment are positively associated with persistence toward achieving academic goals (Bean, 1983; Metzner, 1984). Interestingly, "the two most prominent national reports during this time (i.e., *A Nation at Risk*; National Commission on Excellence in Education [NCEE], 1983; and *To Reclaim a Legacy*, Bennett, 1984)" stressed the need to minimize the growing vocational influence of college curricula and to reestablish the humanities and liberal arts as a central curricular feature in higher education.

Since the early 1990's, two constructs related to academic relevance and grounded in motivational theories generated a fairly deep body of research. Identified regulation, derived from self-determination theory (SDT; Ryan & Deci, 2000), is an internalized extrinsic motivation. It is extrinsic in that it is related to the performance of activities for the purposes of satisfying external demands, or as a means of acquiring a result aside from the enjoyment of the activity itself. It is internalized in that the individual has identified with the personal importance (i.e., relevance) of the activity in terms of their own value system (Jang, 2008). Similarly, the expectancy-value model of achievement choices (Eccles & Wigfield, 2002) posits that the values individuals ascribe to tasks (i.e., task values) contribute to achievement and performance. Utility values are a type of task values that are extrinsic in that their value is perceived as instrumental. However, like identified regulation, utility values can be integrated into one's personal value system and thus become more personally relevant. Both identified regulation and utility value have been associated with greater interest, sustained effort, and achievement in academic settings (Hulleman, Godes, Hendricks & Harackiewicz, 2010; Jang, 2008; Reeve, Jang, Hardre & Omura, 2002).

This body of quantitative literature underscores the associations among academic relevance, academic motivation, academic engagement, and performance. Qualitative research may illuminate deeper and more personal meanings individuals hold about their academic endeavors. For example, it is not known if, or to what extent, students seek academic relevance within different life-domains (i.e., career, civic membership, personal development). Moreover, it is not known to what extent the

meaning students generate around academic work is related to students' individual and societal values. In 1971, 73 percent of entering freshman stated that developing a meaningful philosophy of life was very important while in university (American Council on Education, 1971).

Therefore, it could be assumed that college students at this time perceived a relevant curriculum to be one that facilitated the development of skills needed to search for a meaningful life philosophy. The call for a more relevant curriculum appears to be on the rise again as the competitiveness of a "high tech" globalized market drives students' and parents' current demands for universities to provide the most marketable skills available, as well as the business community's demands for a highly skilled and productive workforce (Bok, 2006; Chace, 2009; Grubb & Lazerson, 2005). Current calls for a curriculum providing clear connections to career paths seem congruent with findings from recent research suggesting that students' motivations for attending university are increasingly centered on job obtainment and earning potential (Astin, Oseguera, Sax, & Korn, 2007; Nathan, 2005; Schneider & Humphreys, 2005).

Yet, it appears that college students do perceive relevance in their academic course work beyond being a means to increase occupational and financial viability. Relatively recent research (Henderson-King & Smith, 2006) indicates that while students are highly motivated by obtaining future earning potential and workforce preparation, they also ascribe broader meaning to the college experience (e.g., opportunity for personal growth, exploration of one's self, and exposure to diverse ideas). However, the notion that students look directly to the academic curriculum as a viable means for making these meanings tangible is highly suspect (Grigsby, 2009; Nathan, 2005). Data suggests that academic relevance is a complex construct; six distinct domains of academic relevance were identified. Students perceived their course work as relevant to their current and future academic endeavors, vocational preparation, and personal growth and development

2.5 Graduates' Perceptions about Curriculum Relevance

Universities are viewed by its stakeholders as having responsibility to provide graduates with fundamental workplace skills, contribute to their achievement of short and long-term career goals and also to provide a satisfying study experience for graduates. Employers especially, expect universities to provide the training and workplace skills that they require within the graduates' repertoire. If the core business of universities is to prepare graduates with skills and knowledge relevant to their chosen vocation, then a gauge of universities' success in achieving this goal is essential. Dawkins (1988, p.18) stated that: "Academics must be able to relate and respond to the national priorities which governments have a responsibilities (sic) to determine, but not impose." The workplace competence debate then gained prominence with the commissioning of the Finn Report (1991) in Australia, which supported the convergence of higher education with defined capability training as with vocational education.

The subsequent Mayer Report (1992) proposed that the Key Competencies should be made explicit in the curriculum. The ongoing debate on graduate competencies has focused on how universities contribute to students' workplace competencies through implementing appropriate curricula, teaching and learning processes and work related experiences. This process has also been informed by both ongoing consultations with industry and measures of graduate employment as indicators of employability and the success of the competency initiatives within universities.

Barrie (2002) commented on lack of research clarifying the underlying conceptual basis of graduate attributes and suggested that there is a difference in academics' understandings of the concept of generic attributes and the processes by which graduates develop such attributes. Barrie (2002) observed that this variation in academics' understandings was one of the many impediments in systematic curricular reform and teaching development aimed at achieving key competencies in graduates as a core outcome of university education. Employability and university education have also been linked by the focus on meeting a generalised workplace demand (key competencies) of employers and the community. Reynolds and Mackay (1997, p.5) reported that students reacted positively to the explicit teaching of key competencies because they provided "a clearer purpose for their learning, a greater appreciation of relationships between education and work, something more meaningful and tangible to strive for, and more hands-on practice, interwoven with subject knowledge." This seamless approach espoused the interchangeability of competency and employability as aspects of the same debate.

The competency/employability debate added pressure for universities to develop curricula that included the teaching of essential discipline skills and general/core competencies addressing workplace needs. Bradshaw (1992), Candy and Crebert (1991) and Leveson (2000) outline the semantic differences between employers and academics in perceptions of generic skills and workplace skills. Leveson (2000,162) concluded that "the identification of skills developed by graduates needs

to be understood and articulated by the individual graduate and understood by employers”. This puts the responsibility on the individual graduate to explain their skills to employers and avoid any shared onus of including educators, management, and policy makers. In ascertaining graduate employment outcomes, government policy makers and senior university managers use current employment statistics that outline a single percentage as an indicator of employability.

Alternatively, they seek the opinion of employers for future trends within the sector and also in regard to the course relevance within industry. Assessing whether graduates are employable is usually a role placed on the private sector and large corporations. Their documentation of recruiting processes, clear selection criteria, and graduate training programs allows for some informed comments on the value of the graduate in their world of work. Nielsen (2000) on employer satisfaction with graduate skills summed that employers had very few complaints regarding the course content of university study. The exception they quoted came from the fast-developing and advanced disciplines of information technology and electronic communications. This compares to Karathanos (1999), who concluded that while course competencies had advanced, the gap between practice and academic research and teaching had widened.

Also, Carnevale et al (1990) report that employers and the business community perceive that higher education programmes are failing to achieve specific, real-world goals in the preparation of students. The essential goal behind employer surveys is to try to ascertain the core competencies required by their workplaces. This assumes that employer perceptions, including CEO's, in-line managers, HR staff or section heads are consistent across levels of the workplace hierarchy. Studies by McCowan & Richardson (1999) showed that there exist differences between skills the graduate perceive as required by their workplace and the skills that their immediate manager suggests are essential for the same position.

This suggests that employers' assessment of the value of university study at present lacks the reliability required by universities and government. Therefore, the post-graduation survey provides an important opportunity to capture crucial data from graduates regarding their study experience and its relation to the demands of their workplace. The capacity to evaluate the inputs from the higher education system based on the graduate experience of the outcomes to study is the primary focus of this research with the testing of a measure of graduate perception of the relevance their university study experiences.

Graduates' perceptions of mathematics relevance are shaped by workplace experiences, professional responsibilities, and career trajectories. Many graduates report limited direct use of advanced mathematical techniques in routine maritime roles, particularly at the operational level. Tasks are often guided by standard operating procedures, manuals, and computerized systems, reducing the need for explicit calculations. Despite this, graduates tend to acknowledge the indirect and enabling role of mathematics in professional practice.

Mathematics contributes to:

- a) Conceptual understanding of engineering systems
- b) Diagnostic reasoning and troubleshooting
- c) Adaptability to new technologies and systems
- d) Confidence in decision-making under uncertainty

These retrospective insights suggest that mathematics relevance becomes more apparent over time, as graduates encounter complex or non-routine situations that require analytical reasoning. Mathematics is thus, recognized as a foundational competence rather than a frequently used tool. Graduates' reflections highlight a temporal dimension of curriculum relevance: what appears irrelevant during training may later be appreciated as essential. This underscores the importance of preparing students not only for immediate job tasks but also for long-term professional growth and adaptability.

2.6 Tension Between Academic and Vocational Relevance

A central theme emerging from students' and graduates' perceptions is the tension between academic and vocational relevance. Mathematics is widely valued for academic progression but perceived as less immediately applicable to maritime work. This tension reflects broader challenges in engineering education, where curricula must balance theoretical rigor with practical applicability. In MET institutions, this balance is further complicated by regulatory requirements, international standards, and traditional pedagogical models. Mathematics curricula are often influenced by historical academic structures rather than contemporary maritime practice. As a result, learners may struggle to see how mathematical learning aligns with

their professional identity as marine engineers. Importantly, the findings suggest that students and graduates do not reject mathematics itself. Rather, they question its visibility, contextualization, and alignment with maritime career pathways. Addressing this tension requires a shift from viewing mathematics as a stand-alone subject to positioning it as an integrated component of marine engineering education.

3. RESEARCH METHODOLOGY

The study adopted a mixed-methods research design (specifically, a *convergent parallel design*) where quantitatively, it measured perceptions, levels of relevance, and alignment of the curriculum statistically; and qualitatively, the study attempted to gain deeper insights into experiences, perceived gaps, and recommendations through focus groups discussions. This design was chosen because perception studies benefit from both measurable trends and in-depth explanations. The study population included current students enrolled in maritime education and training (MET) programs; and graduates of the maritime education and training programmes who are currently working in the maritime related fields. A total of 139 Levels 300 and 400 students of marine engineering and nautical Studies students were sampled using stratified random sampling whilst purposive sampling method was used to draw 19 graduates who are currently employed in maritime professions. Questionnaires and Semi-structured interviews (with selected students and graduates) were used for data collection. Focus group discussions were employed to triangulate the validity of the data gathered.

4. DATA ANALYSIS

Many are the reasons why someone who enters university would be interested in offering a particular course or programme. For mathematics to be that choice made by one who enters a university, there must be a real need for it since mathematics has arguably been among the “most hated” courses/subjects in a school system. As earlier indicated in chapter one, the first question the study sought to answer is to determine the students’ and graduates’ perception about the relevance of the Regional Maritime University marine engineering mathematics curriculum to the graduates in terms of its utility value, other disciplines, and the career world here referred to as STEAM skills development.

Table 1: Perception of relevance of mathematics to marine engineering practices

		Students’ and graduates’ Responses		
		Yes	No	Total
Statements about the relevance of mathematics programmes		N (%)	N (%)	N (%)
1	Do you consider offering a course in mathematics necessary in university?	129 (93%)	10 (7%)	139 (100%)
2	Do you consider offering a course in mathematics relevant in university?	129 (93%)	10 (7%)	139 (100%)
3	Did you find the mathematics courses relevant to each other (that is, after offering Maths I, did you find it helpful in understanding Maths II, and so on)?	131 (94%)	8 (6%)	139 (100%)
4	Did you take other non-mathematics courses during the RMU programme that required the application of mathematical concepts and skills?	130 (94%)	9 (6%)	139 (100%)
5	Were the mathematics courses you offered helpful in understanding the other non-mathematics courses you offered?	132 (95%)	7 (5%)	139 (100%)
6	Do you find the mathematics courses you offered helpful in your current profession or daily work?	49 (83%)	10 (17%)	59 (100%)
7	Has there been a situation where you realized that the non-mathematics courses you offered would have been better understood if a particular mathematics course/content had been studied first?	118 (85%)	21 (15%)	139 (100%)
		91%	9%	100%

In order to re-establish the grounds for the study for answering this question, the researcher quizzed the respondents on whether they considered mathematics study necessary in pursuing a university programme after all. The question was interrogated with seven sub-items administered through questionnaires. The results of the respondents are presented in Table 1.

Table 1 shows that the majority of 139 respondents who answered this set of questions, 129 representing 93% considered offering a course in mathematics very necessary for a university programme. The participants' perception of the relevance of the MET mathematics curriculum was operationally defined in terms of how they found the mathematics courses relevant to their study of other courses and future careers; how they considered offering a mathematics course in university, the extent to which they agreed the mathematics courses studied facilitated their learning in non-mathematics courses, and extent to which they agreed mathematics courses helped them to develop knowledge and skills needed in marine related careers and daily life. The responses of the items on the relevance of the MET mathematics curriculum were aggregated and Table 2 presents the descriptive statistics on this variable.

Table 2: Descriptive statistics on ratings of the relevance of MET mathematics curriculum

Rating	N	Min	Max	Mean (\bar{y})	S.D (σ)
Rating of Relevance of MET Mathematics	106	7	12	11.4	0.9
Rating of self-efficacy beliefs in mathematics	102	2.25	4.42	3.65	0.46

(Missing N=34, 24.3%)

The responses of the items on the relevance of the MET mathematics curriculum were aggregated in Table 2. Initial analysis showed the respondents rated their overall self-efficacy beliefs in mathematics as average (Mean = 3.65, SD= 0.46), that is, neither moderate nor low. The overall mean scores were used as the proxy scores for the respondents' self-efficacy beliefs in mathematics. A mean value below or equal to 3.5 was taken as a low self-efficacy belief in mathematics and a mean value above 3.5 was taken as a moderate self-efficacy belief in mathematics.

- *Is mathematics helpful in understanding further mathematics?*

When the respondents were asked, 'Were the mathematics courses you studied helpful in understanding further mathematics topics in the subject as well as other non-mathematics courses', a clear majority of 131 representing 94% agreed to the view that the courses offered in mathematics in the university as part of the Maritime Education and Training programme are helpful in understanding other mathematics courses/topics whereas 95% agreed that the mathematics courses were helpful in understanding other non-mathematics courses such as circuit theory, naval architecture and materials science among others. It can therefore be argued that majority of the respondents (i.e. over 80%) were emphatic that the subject mathematics is very necessary to study in school, especially in the university.

- *Is mathematics helpful to the practice of your job and future career?*

The study also examined how the respondents in the sample perceive the relevance of the subject to maritime education and training and to their future careers. The respondents were asked to indicate if they *find the mathematics courses they offered helpful in their current profession or daily work?* From Table 1, a total of 59 participants responded to this item of whom 49 (83%) responded 'Yes' indicating that mathematics is very helpful to their job delivery. The 10 (17%) who said No., explained that the mathematics they need to perform at work is not what they studied at school. They explained further, that but for further studies as engineering students they would have recommended removal or a major change in the contents of the mathematics they studied in their entire marine engineering programme.

- *Which factors motivate you to study mathematics in university?*

The study observed from the industrial interactions (interviews) that many factors contribute to the reasons why one would recommend mathematics study for a student that is not offering a pure mathematics based programme such as engineering in the university. The respondents were asked to rank five of the major reasons that might influence their decision to recommend mathematics as a course for study to a colleague. The results of are presented in Table 3.

Table 3: Ranking of reasons for recommending a course of study in mathematics for engineering students

s/n	Reasons for the rating	N	Mean (\bar{y})	Std. Dev.(σ)
1	Academic progression	130	2.15	1.267
2	Understanding other subjects	130	2.38	1.302
3	Efficiency in industry	130	2.64	1.3106
4	Professional growth	130	2.80	1.4105
5	Job preference	130	3.45	1.489

The results in Table 3 show that “academic progression” ($\bar{y} = 2.15$, $\sigma = 1.267$) was ranked as the most important reason for vouching for the inclusion of mathematics in the university’s Maritime Education and Engineering Training programme. This was followed by “Understanding other subjects” ($\bar{y} = 2.38$, $\sigma = 1.302$), “Efficiency in industry” ($\bar{y} = 2.64$, $\sigma = 1.3106$), “Professional growth” ($\bar{y} = 2.80$, $\sigma = 1.4105$), and “Job preference” ($\bar{y} = 3.45$, $\sigma = 1.489$) in that order of importance as arranged in the Table 3.

The results indicate that the major reasons that influence respondents’ decision to recommend mathematics as a course for study to a colleague are not career oriented, that is, not related to getting marine engineering jobs, but rather academic (see Table 3). It can therefore be argued that students, staff and graduates of the maritime education and training institutions see mathematics as very relevant and necessary for their academic growth and developing understanding of what they learn in the university.

- *Why would you recommend mathematics for non-engineering programmes?*

The respondents were also asked to rank some major reasons that would influence their decision to recommend the study of mathematics content for non-engineering programmes in RMU. The results are presented in Table 4.

Table 4: Ranking of reasons for recommending mathematics content for non-engineering programmes in RMU

s/n	Reasons for the rating	N	Mean (\bar{y})	S. D. (σ)
1	Academic progression	127	2.96	2.033
2	Understanding other subjects	129	3.29	2.032
3	Efficiency in industry	129	3.39	2.017
4	Professional growth	129	3.80	2.202
5	Specifically, for an engineering discipline	129	3.99	2.416
6	Changing trends in technology	129	4.05	2.580
7	Job preference	128	4.23	2.557
8	Industrial job function	129	4.47	2.325

Again, the results in Table 4 show that academic progression which has the minimum mean value showing consistency (Mean= 2.96, SD =2.033) was ranked as the most important reason for recommending mathematics content for non-engineering programmes in RMU. This was followed by ‘understanding other subjects (Mean=3.29, SD =2.032)’ and ‘efficiency in industry (Mean = 3.39, SD = 2.017)’ with last being ‘industrial job function’ (Mean = 4.47, SD = 2.325) in that order. The results indicate that the major reasons that influence students’ and graduates’ perception to recommend mathematics content for non-engineering programmes in RMU are largely academic in nature and not career oriented. Also, interview results on this item confirm that the graduates of the university who are in the industry do not see the role of mathematics in their day to day job functions.

Focus group discussions explored areas such as students’ and graduates’ experiences with mathematics courses; application of mathematics in maritime training; workplace relevance of mathematics as well as identified gaps in the mathematics and the curriculum improvement suggestions

Enhancing relevance, therefore, requires curriculum design and pedagogical strategies that:

- Explicitly link mathematical concepts to marine engineering applications
- Align mathematics instruction with concurrent engineering and technology modules
- Use applied problems, simulations, case studies, and industry-informed examples
- Emphasize the role of mathematics in safety, risk management, and system reliability

Such approaches would strengthen both perceived and actual relevance, supporting deeper learning and professional identity formation.

The results indicate that the major reasons that influence students’ and graduates’ perception to recommend mathematics content for non-engineering programmes in RMU are largely academic in nature and not career oriented. Also, interview

results on this item confirm that the graduates of the university who are in the industry do not see the role of mathematics in their day to day job functions.

One interviewee stated,

“...I do not see why we needed to do all that mathematics in order to do what I am doing at work today, if not for further studies...” (A graduate of the university)

It can therefore be argued that students, staff and graduates of the maritime education and training institution see mathematics as very relevant and necessary in non-engineering programmes in RMU. This, again, suggests that the students and graduates of the Maritime Education and Training institution view industrial job function almost always as having nothing or very little to do with mathematics study since the contents of the marine engineering mathematics curriculum are often too high and unrelated to the industrial job function of its graduates.

Discussion and Implications for MET Curriculum Mathematics Development

To improve perceptions of relevance, MET institutions such as RMU should consider the following strategies:

- (i) Integrating mathematics more closely with engineering and technology modules
- (ii) Emphasizing application-driven learning without sacrificing theoretical depth
- (iii) Collaborating with industry stakeholders in curriculum review and design
- (iv) Using interdisciplinary teaching teams to highlight cross-curricular connections

These measures would support the development of mathematically competent graduates who understand and appreciate the role of mathematics in both academic and professional contexts.

The findings reveal that while mathematics is widely perceived as academically relevant, its vocational relevance is less visible to learners, particularly during training. Graduates tend to recognize the value of mathematics retrospectively, highlighting its indirect but critical role in professional competence. RMU management should consider using the positive results obtained on the students' perceived relevance of the mathematics curriculum in advertising in order to attract students into the university's engineering and non-engineering programmes. Addressing this disconnect requires deliberate curriculum integration, contextualized pedagogy, and alignment with maritime career pathways. Strengthening curriculum relevance is essential for producing competent, adaptable, and industry-ready maritime professionals capable of navigating the evolving demands of the global maritime sector.

5. SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This study has examined students' and graduates' perceptions of the relevance of the MET mathematics curriculum to their studies and future careers, using the Marine Engineering programme at RMU, Ghana, as a case study. The study first revealed that the majority (93%) of the RMU students and graduates consider offering a course in mathematics as necessary and relevant for their studies and future careers. That is, the majority of the respondents perceived the RMU mathematics curriculum as relevant to their programme of study and for further academic pursuits. The findings indicate that while the MET mathematics curriculum is widely perceived as relevant for academic progression and conceptual understanding, its relevance to professional maritime practice is less visible to learners, particularly during training. Graduates, however, tend to retrospectively acknowledge the indirect and enabling role of mathematics in professional competence and adaptability. The study argues that enhancing curriculum relevance requires deliberate contextualization, pedagogical integration, and closer alignment of mathematical learning with maritime career pathways and industry practices.

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