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Review

Exploring the Role of TESOL in Enhancing Education for Marine Engineering undergraduate students: A Literature Review

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Abstract: The utilization of English within the domain of marine engineering holds paramount significance, especially as exploration of the oceans continues and the field of marine engineering undergoes globalization. Nevertheless, traditional English education in marine engineering exists certain shortcomings. Teaching English to Speakers of Other Languages (TESOL), as an educational technology, harbours the potential to overcome these deficiencies. This paper conducts an analysis of the current state of marine engineering English education and related research areas, while scrutinizing the application needs and characteristics of marine engineering English. These analyses are compared with the attributes of TESOL education technology to explore its potential applicability. This paper provides a comprehensive examination of the field, pinpointing its inherent limitations. Among these challenges are hurdles in educator training, technical complexities, and a paucity of teaching resources. Additionally, it offers insightful recommendations for advancement and outlines promising prospects for the future. Essentially, this paper serves as a commendable coupling of arts and sciences, offering a valuable reference point for the advancement of English language education within the realm of marine engineering.

Keywords: Coupling of arts and sciences; Educational technology; Marine engineering English education; Teaching English to Speakers of Other Languages (TESOL)

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1. Introduction

The oceans represent a vast reservoir of resources on Earth, exerting a profound influence on the advancement of human society [1-3]. In the wake of the rapid progress of science and technology, the commercial exploitation of oceanic resources has gained momentum, leading to a substantial growth in the ocean economy and heightened governmental attention. Consequently, the cultivation of marine engineering talents has become increasingly crucial [4,5].

In today's globalized world, international cooperation in the field of ocean engineering has become increasingly frequent and vital [6,7]. Effective communication is crucial for the advancement of this discipline. Ocean engineering is a multidisciplinary field that integrates offshore floating structures [8,9], marine energy [10,11], information technology [12,13], novel materials [14,15], and other disciplines [16-18], resulting in a complex knowledge system. As the predominant language used in international communication, norm-setting, and research paper writing, proficiency in English is essential for the success of ocean engineering students in their academic endeavours and future careers. As Figure 1 shows the main applications of English in the field of marine engineering. As shown in Figure 2, the use of English in engineering education is gradually receiving attention. Traditional English education in marine engineering is encumbered by numerous limitations. These include outdated teaching content, a lack of practical application, reliance on singular teaching methods, limited interactivity, constrained teaching resources, inadequate practice opportunities, uniform evaluation approaches, a deficiency in comprehensiveness, and a dearth of interdisciplinary and multicultural training. The Teaching English to Speakers of Other Languages (TESOL) approach holds promise in addressing several challenges inherent in traditional English education for marine engineering. With its emphasis on communication, practical teaching methodologies, diverse instructional techniques, and adaptable curriculum updates, TESOL has the capacity to bridge the gap between theory and practice, address deficiencies in practical instruction, overcome reliance on singular teaching methods, and facilitate the timely incorporation of new knowledge.

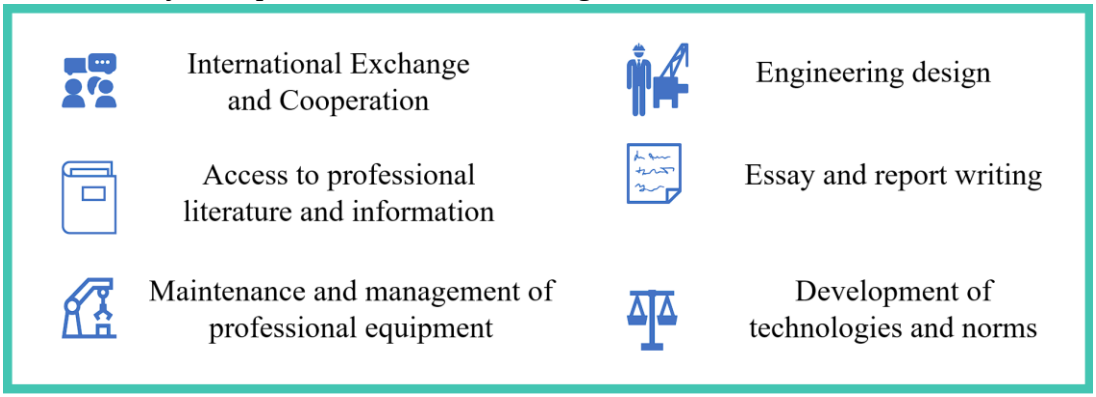

Figure. 1. Main applications of English in the field of marine engineering.

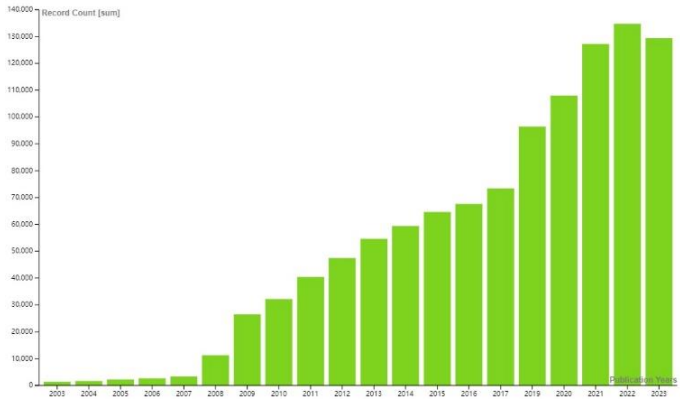

Figure. 2. The number of published results about English for Engineering Education from 2003-2023 in the Web of Science.

The primary objective of this paper is to investigate the potential applications of Teaching English to Speakers of Other Languages (TESOL) in the realm of English language education for marine engineering. It commences by underscoring the significance of English proficiency within the domain of marine engineering. Given the limited existing research on English language education tailored specifically for marine engineering, this paper fills this gap by examining case studies from related fields such as maritime English education and English for engineering education. Moreover, the paper delves into the specific needs of marine engineering regarding English language proficiency. It then proceeds to review and analyse key educational methods employed in TESOL. Through a comparative analysis of these methods, their characteristics, and the demands of marine engineering for English proficiency, alongside current shortcomings in English education within related fields, the paper explores the potential for integrating TESOL educational technology.

By identifying deficiencies within the field and proposing developmental suggestions, this paper aims to serve as a guiding resource for advancing English language education in marine engineering. Ultimately, it seeks to contribute to the enhancement of English language proficiency among marine engineering students, thereby better preparing them for success in their professional endeavors. The basic framework of this paper is illustrated in Figure 3.

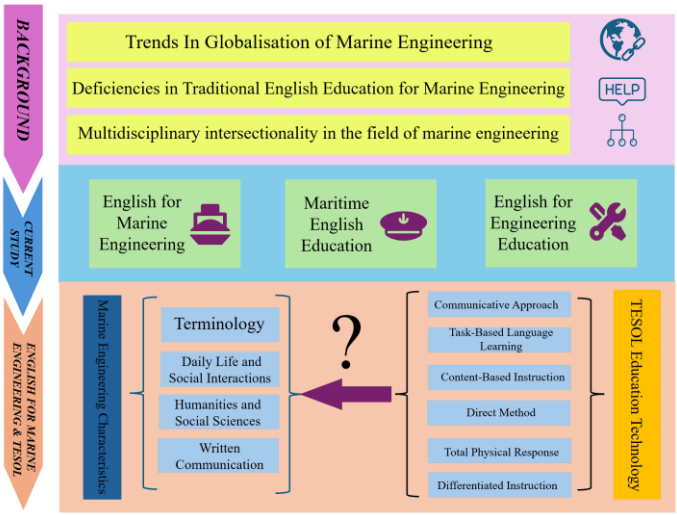

Figure. 3. The technical line of this paper.

2. The Significance of English in Marine Engineering

English plays a crucial role in marine engineering education primarily as an international lingua franca [19]. It enables students to communicate effectively across cultures and grasp international standards, norms, and the latest research findings. Moreover, English offers an extensive array of learning materials, such as literature, textbooks, and online courses, which facilitate students' comprehensive exploration and research within the realm of ocean engineering.

2.1 Importance for Subsequent Careers in Related Industries

In recent times, much of the advancement in marine engineering has been spearheaded by Western nations. Particularly following the industrial revolution, the engineering prowess of these countries has experienced exponential growth and refinement [20-22]. Consequently, it's natural for native English to be the language of choice for drafting specifications and documenting research findings. These early studies serve as the bedrock for subsequent advancements in the field of marine engineering. Additionally, English, known for its simplicity and precision, aptly caters to the linguistic demands of engineering-focused publications [23]. Moreover, influential international bodies such as the International Maritime Organisation (IMO) and the International Organisation for Standardisation (ISO) have adopted English as the lingua franca for crafting international standards and guidelines in offshore engineering. The pervasive influence and credibility of these global organisations have further solidified English's prevalence in the realm of offshore engineering.

According to the statistics from the International Maritime Organization (IMO), 80% of accidents at sea stem from human error, with half attributed to inadequate communication [24]. In the maritime industry, the absence of effective verbal communication might appear trivial, yet it can precipitate grave marine accidents, culminating in loss of life, injuries, and extensive property damage [26-28]. Hence, ensuring proficient communication skills among individuals affiliated with marine engineering is paramount.

2.2 Importance of The Learning of Relevant Knowledge

Our analysis is anchored in esteemed rankings, including the "Best Universities for Marine Engineering in the World" by EduRank 2024, the Shanghai Ranking in Marine and Offshore Engineering for 2024 [29], the QS 2023 Civil and Structural University Rankings [30], and the US News Civil Engineering Rankings for 2022-2023 [31]. By scrutinizing the top 50 institutions across these rankings, as illustrated in Figure 4, we discern a conspicuous clustering of premier universities in nations where English is the predominant language, while fewer institutions from non-native English-speaking countries attain top rankings.

Consequently, it follows that high-quality teaching, research, and academic resources in the domain of marine engineering are predominantly available in English. Non-native English speakers aspiring to leverage these resources to their fullest extent must possess a

certain level of proficiency in English. This proficiency is essential for comprehending course materials, engaging with instructors and peers, and conducting requisite academic research.

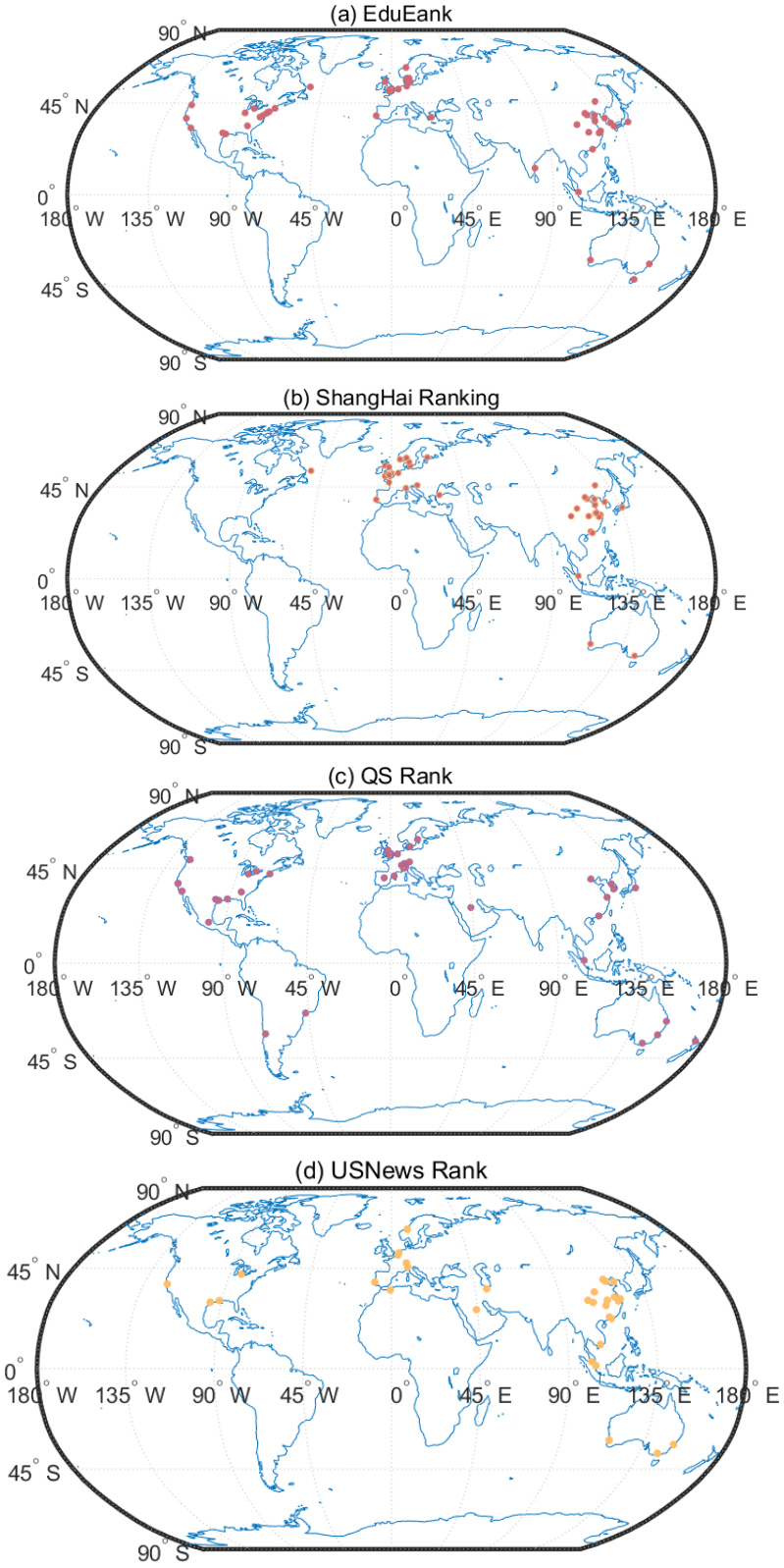

Figure. 4. Distribution of the world's top 50 marine engineering-related universities and colleges (a)EduRank 2024, from https://edurank.org/engineering/marine/. (b)Shanghai ranking 2024, from https://www.shanghairanking.cn/rankings/gras/2023/RS0222. (c) QS ranking 2023 from https://www.topuniversities.com/university-subject-rankings/civil-

structural-engineering.(d)USNews ranking 2022-2023 from
https://www.usnews.com/education/best-global-universities/civil-engineering.

3. English Education for Marine Engineering at the Current Stage

Given the scarcity of research on English language education specifically tailored for marine engineering, this paper examines case studies from three related areas: marine engineering, maritime English, and English for engineering education.

3.1 Mindset and Culture

Timofeeva and Oksana advocate for a shift in maritime higher education English language programs towards prioritizing the cultivation of critical thinking skills among future ship mechanics. They argue that such skills are fundamental for the development of professional competence in this field. Critical thinking entails not only the processing of information and effective professional communication but also encompasses the aptitude for comprehending, categorizing, and evaluating information accurately. By incorporating training in critical thinking techniques within the English language curriculum, students can better prepare themselves for the demands of their future careers at sea while enhancing their cross-cultural communication abilities [32].

Fan et al. delved into the communication abilities of Chinese seafarers within the maritime domain, with a specific emphasis on English proficiency, highlighting the significant role of linguistic and cultural elements. Their findings revealed shortcomings among Chinese seafarers in language proficiency, pragmatic competency, and cross-cultural comprehension, which constrain their competitiveness in the global maritime job market. The study advocates for a reform in maritime English education, emphasizing the enhancement of practical communication skills. Proposed measures include augmenting cross-cultural teaching materials, establishing online learning platforms, and fostering self-directed English learning abilities among seafarers [33].

Michael et al. conducted an exploration into the portrayal of culture within engineering education and pedagogical approaches. Their study involved synthesizing and analyzing engineering education literature spanning from 2000 to 2015. It underscored the imperative for engineers to possess effective communication skills within multicultural and multilingual teams, essential for addressing the demands of an increasingly globalized professional landscape [34].

Lisa and Fernhaber investigated the effects of integrating inquiry-based instructional modules into a college-level English as a Foreign Language (EFL) curriculum on students' workplace communication skills and collaborative mindset. Their study focused on nurturing students' social, collaborative, and problem-solving abilities through various teaching strategies, including co-teaching in academic and industrial settings, industry excursions, reflective writing, and project-based presentations. The results indicated that inquiry-based teaching and learning methodologies positively influenced student engagement and the acquisition of practical skills such as critical thinking, collaboration, and communication [35].

3.2 Standard-Setting

Ziarati et al. highlight the crucial role of maritime English standards in enhancing safety at sea. They underscore the necessity of crafting unified maritime English standards at both international and European levels, which are presently lacking. The EU MarTEL project endeavors to fill this gap by formulating a comprehensive set of standards via innovative knowledge transfer. These standards will delineate distinct English language prerequisites tailored to various categories of seafarers, spanning beginner, intermediate, and advanced proficiency levels, while placing significant emphasis on diverse language competencies [36].

Agbing et al. evaluated the performance of a maritime tertiary education institution in the Philippines regarding its adherence to the standards outlined in the International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW). Their assessment specifically examined the institution's proficiency in supervising and managing training and assessment processes. The study called upon the maritime industry to enhance its training programs and governance structures to elevate the quality of maritime education in the Philippines. This improvement is crucial for ensuring conformity with international standards and sustaining the country's leading position in the global seafarer supply market [37].

3.3 Needs Analysis

Alibakhshi et al. conducted an assessment of the task-based language requirements pertinent to maritime engineering students both during their academic training and in their prospective professional roles. Through semi-structured interviews involving 20 maritime engineering educators and students, the study elucidated a spectrum of language tasks encountered by these individuals. Findings revealed that throughout their academic pursuits, maritime engineering students are confronted with 17 distinct task-based language necessities. These encompass activities such as grasping the essence of technical texts, dissecting course content, and delivering oral presentations. These tasks underscore the imperative for a robust integration of language proficiencies across listening, speaking, reading, and writing domains [38].

Alibakhshi et al. rigorously gathered and examined the academic task-based language requisites of maritime engineering students through a quantitative survey methodology. Their investigation unveiled a multifaceted set of language competencies essential for both academic pursuits and practical application. These include proficiency in understanding technical literature, composing reports, delivering presentations, engaging in shipboard communication, and effectively managing emergency situations, all of which are integral to their educational journey and future professional endeavors. Notably, teachers accorded a markedly greater significance to these language needs compared to students, underscoring the perceived importance of linguistic mastery in the maritime engineering domain [39].

Ahmmed et al. employed a mixed methods approach, gathering both quantitative and qualitative data from 135 senior maritime cadets and 24 recruitment agencies. Their research

revealed that among 68 maritime tasks conducted aboard ships, 23 were deemed as "highly desirable" skills by respondents. Notably, effective communication, specifically speaking proficiency, emerged as the most critical skill according to the findings [40].

3.4 Teaching Methods

Tominac's investigation delved into the existing teaching resources employed in instructing Maritime English to marine engineers. The study unearthed a predominant emphasis on language accuracy and reproduction within the current instructional materials, with a notable dearth of focus on fluency development. Consequently, Tominac advocates for a shift towards augmenting communicative teaching methodologies to foster a more balanced cultivation of students' communicative competence. By integrating more communicative teaching activities into the curriculum, educators can effectively promote the holistic development of students' language proficiency, thereby better preparing them for the demands of maritime communication in real-world contexts [41].

Ding et al. explore the implementation of an English for Specific Purposes (ESP) blended teaching approach using the "Ke Tang Pai" platform, with a focus on the course "Listening and Speaking English for Shipbuilding Engineering." The article identifies key challenges in the current teaching methodology, including limited class time, reliance on a singular teaching mode, and assessment methods deemed as inadequate. To address these issues, the authors propose a blended ESP teaching model comprising three distinct phases: pre-class, in-class, and post-class activities. Leveraging the functionalities offered by the "Ke Tang Pai" platform, such as online interaction, homework evaluation, and test grading, the model amalgamates the benefits of both online and offline instruction. This integration aims to enhance student engagement, motivation, and the overall quality of course delivery [42].

Yercan et al. underscore the inherent challenge within teaching methodologies, particularly in the context of Maritime English, which demands high specialization and practical applicability. Traditional English teaching methods often fall short in fully addressing the unique requirements of Maritime English instruction. Mastery of Maritime English not only entails proficiency in basic language skills but also necessitates a comprehensive understanding of specialized terminology and operational procedures within the maritime domain. Moreover, the diverse student demographics pose an additional layer of complexity in Maritime English education. With varying levels of English proficiency, diverse learning backgrounds, and disparate professional knowledge, instructors must adeptly adapt their teaching methodologies to cater to the individual needs of each student. Flexibility in teaching strategies is paramount to accommodating the diverse learning needs within the student population effectively [43].

Miguel et al. propose enhancing students' communication and critical thinking skills by organizing weekly lectures on engineering topics in English, which is not their native language. These lectures serve to improve students' technical knowledge and oral presentation skills while also concentrating on non-verbal communication, the design of presentation materials, and role-playing techniques for speakers. The aim is to provide

students with a robust foundation for communication and career development in a globalized market [44].

Shi and Fan's study highlighted several issues and obstacles within online maritime education (ME) in China, particularly concerning materials, assessment, feedback, interaction, and support. They observed that the design of online learning materials tends to be rudimentary and antiquated, failing to align with contemporary needs and standards. Additionally, online assessment and feedback often overlook individual requirements, while interaction is predominantly confined to basic Q&A sessions between instructors and students. Although many Chinese maritime education institutions offer online tools and auxiliary resources to aid student learning, the current support mainly focuses on technical assistance and access to library materials [45].

James et al. investigated the potential of employing an authentic pedagogy to enhance maritime communication. This method prioritizes the utilization of genuine language materials and the simulation of communication scenarios reflective of real-world maritime settings. The aim is to enhance learners' language proficiency and practical application by providing them with opportunities to engage with authentic communication contexts [46].

4. The Relationship between Specialized Needs in Marine Engineering and English Education

4.1 Marine Engineering English Features

Based on the preceding review and the authors' research experience in marine engineering, it has become apparent that the application of marine engineering English encompasses four primary domains: terminology, daily life and social interaction, humanities and social sciences, and written communication in English. As shown in Figure 5. In this section, we will provide concrete examples to elucidate the key characteristics of English for Marine Engineering. These examples will serve as a foundation for subsequent subsections, which will explore the potential of Teaching English to Speakers of Other Languages (TESOL) in English language education for marine engineering.

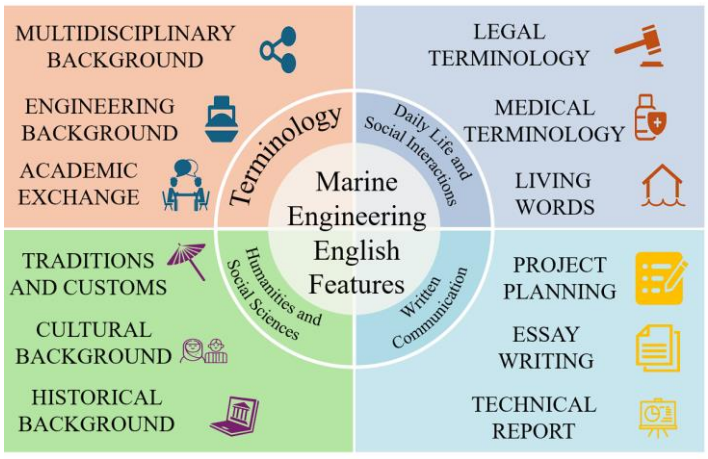

Figure. 5. Marine Engineering English application features.

4.1.1 Terminology

In marine engineering English education, terminology plays a pivotal role as it encompasses structural terms for marine engineering equipment, descriptions of equipment operations, and comprehension of maritime directives [47-50]. These specialized terms not only form the foundational vocabulary within the realm of marine engineering but also serve as the cornerstone for comprehending and conveying concepts pertinent to marine engineering. Proficiency in terminology not only enhances students' grasp of both the theoretical underpinnings and practical applications of marine engineering but also facilitates effective communication and collaboration among peers within the field. Moreover, the acquisition of terminology is integral to nurturing students' professionalism and vocational competence, equipping them to excel in diverse marine engineering projects and tasks throughout their careers. Therefore, the systematic acquisition and mastery of terminology in marine engineering English education are indispensable for students' learning and career advancement. It not only fosters a deeper understanding of the discipline but also empowers students to navigate and excel within the dynamic landscape of marine engineering.

Indeed, learning the English terminology of these specialized terms in marine engineering presents certain challenges. Firstly, marine engineering is a highly interdisciplinary field, necessitating mastery of terminology and concepts across various disciplines. This demands students to possess a broad knowledge base and the ability to learn across diverse areas of study. For instance, consider several research focal points in ocean engineering. The technology of wave energy generation based on friction nano-generation [51] encompasses disciplines such as materials science [52], electrical engineering [53], and hydrodynamics [54]. Similarly, underwater robotics involves fields like artificial intelligence [55] and mechanics [56], expanding the scope of knowledge required for effective understanding and communication.

Secondly, the terms and expressions commonly used in marine engineering English may diverge from everyday English, requiring special learning and adaptation by students. For instance, "lumped mass method" [57,58]in marine cable engineering might not directly translate to its everyday English counterpart. Variations such as "concentrated mass method" or "condensed mass method" may be more accurate translations, highlighting the importance of context and specialized terminology in marine engineering. Similarly, equipment names like "umbilical cable" [59,60] in marine pipelines might evoke confusion among beginners due to its similarity to the medical term "umbilical cord".

4.1.2 Daily Life and Social Interactions

Absolutely, the acquisition of everyday language skills holds significant importance in marine engineering English education. Despite being a specialized field, professionals in offshore engineering must interact with a diverse range of individuals, including colleagues, clients, academics, and others involved in related industries. This necessitates not only a proficiency in specialized terminology within marine engineering but also a strong command of English for everyday communication in various contexts [61].

Moreover, offshore engineering projects often entail cross-border collaboration or international exchanges, underscoring the necessity for a proficient command of English in daily life. Effective communication and cooperation with international counterparts require the ability to express oneself clearly and interact fluently in English across a variety of everyday situations. Therefore, mastering both specialized terminology and everyday language skills in English is essential for success in the field of marine engineering [62-63].

4.1.3 Humanities and Social Sciences

In the field of marine engineering, which often involves frequent and close international cooperation, it is crucial to incorporate the study of culture, tradition, history, and other humanities and social sciences into English education for marine engineering. This holistic approach enriches students' understanding and provides them with a broader perspective [64].

Firstly, the exploration of humanities and social sciences such as history, sociology, and cultural studies allows students to grasp the historical context and societal influences shaping the evolution of marine engineering. This comprehensive understanding facilitates a more profound learning experience in English for marine engineering, fostering the development of English thinking alongside technical proficiency [65].

Secondly, engagement with humanities and social science disciplines nurtures students' critical thinking and interdisciplinary skills. These competencies empower them to comprehend and address the multifaceted challenges encountered in marine engineering, thus fostering innovation and advancement in the field. By integrating humanities and social sciences into English education, marine engineering students are better equipped to navigate the complexities of global collaboration and drive progress in their field.

4.1.4 Written Communication

Strong English writing skills are crucial for undergraduate marine engineering students, especially for those whose native language isn't English. Whether their career path leads to engineering practice or research, proficient writing abilities offer a significant advantage. In ocean engineering, precision and clarity in writing are indispensable for tasks such as project planning, technical documentation, and effective communication. Moreover, the study of writing cultivates students' logical thinking and presentation skills, empowering them to articulate complex concepts and technical content accurately. Thus, the significance of English language writing education in marine engineering cannot be overstated [66,67].

4.2. Characteristics of TESOL

Teaching English to Speakers of Other Languages (TESOL) typically encompasses a comprehensive teaching methodology. Its subject areas span language teaching theory, language acquisition, teaching methodology, materials design, curriculum development, assessment, and testing. The pedagogical aim of TESOL technology is to facilitate learners

in acquiring proficiency in listening, speaking, reading, and writing English, enabling them to effectively use English in intercultural communication and globalized environments [68-70]. The primary teaching techniques in TESOL encompass communicative approach, task-based learning, content-based instruction, direct method, total physical response (TPR), and differentiated instruction. As shown in Figure 6. These methodologies hold immense potential to address the teaching requirements and overcome existing shortcomings in marine engineering English education.

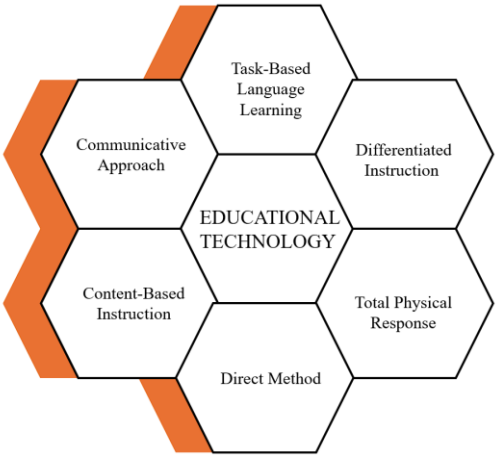

Figure. 6. TESOL's main educational technologies.

4.2.1 Communicative Approach

The communicative approach is a teaching methodology centered around cultivating students' communicative competence, enabling them to confidently engage in authentic language-based interactions. In the context of English education for marine engineering, this approach fosters active participation and language use among students through diverse teaching activities like group discussions and situational dialogues grounded in engineering contexts [71]. By immersing students in such activities, they can enhance their English proficiency for marine engineering. However, the interactive nature of this approach may pose challenges in classes with a large number of students. Moreover, the absence of explicit grammar instruction in this methodology could result in gaps in students' language proficiency [72].

4.2.2 Task-Based Language Learning

Task-Based Language Teaching (TBLT) is a pedagogical approach that intertwines language learning with practical application. It empowers learners to acquire and utilize language skills while tackling real-world problems and accomplishing objectives through meaningful tasks. This method fosters genuine communication, heightens motivation, nurtures self-directed learning, incorporates multilingual abilities, and caters to the diverse needs of learners. However, TBLT also presents challenges. It demands a high level of skill from educators in task design and instruction, particularly in specialized fields like marine

engineering English education, where proficiency in both marine engineering and English is essential. Furthermore, variations among learners may yield differing learning outcomes. Hence, teachers must consider learners' characteristics, educational goals, and available resources when implementing TBLT to ensure task effectiveness and teaching success [73-75].

4.2.3 Content-Based Instruction

Content-Based Instruction (CBI) seamlessly integrates language teaching and subject content to enhance students' language proficiency while immersing them in specific subject matter. This approach allows students to refine their language skills while acquiring knowledge in various subjects through the use of the target language in the curriculum [76].

The advantages of CBI are manifold. It provides students with an authentic and meaningful language-learning environment, simultaneously fostering the development of subject knowledge, motivation, and overall learning effectiveness. However, the comprehensive nature of CBI also presents certain challenges in teaching and learning. These challenges may include potential difficulties such as ensuring adequate alignment between subject content and language teaching objectives, as well as ensuring teachers possess a thorough mastery of the subject content [77,78].

4.2.4 Direct Method

The Direct Method advocates for language acquisition through direct language use and immersion, placing a strong emphasis on oral communication and everyday language usage while minimizing reliance on translation and grammatical rules. Its strength lies in its ability to teach language through contextual and non-verbal cues, facilitating natural language acquisition, improving oral communication skills, and enabling students to use language in authentic contexts [79].

However, challenges exist with this approach, particularly in non-English dominant countries where teachers may lack sufficient language proficiency and fluency to effectively implement it. Additionally, the exclusion of the mother tongue may pose comprehension difficulties for beginners or those unfamiliar with the target language [80].

4.2.5 Total Physical Response

Total Physical Response (TPR) is a language teaching methodology developed by American psychologist James Asher in the late 1960s. It intertwines language learning with physical movement, prompting learners to listen to instructions in a foreign language and promptly respond with corresponding physical actions. At its core, the TPR method mirrors the natural process by which children acquire their first language, prioritizing the development of speaking skills through the enhancement of listening comprehension. TPR offers several advantages, including heightened student engagement and interest, as well as

increased language learning efficiency. However, its effectiveness may be hindered by individual differences among students, and it may not be suitable for all learners [81-83].

4.2.6 Differentiated Instruction

Differentiated instruction is an approach that employs a variety of teaching methods and strategies to address the diverse learning needs of students based on their individual differences. By tailoring content, teaching methods, and assessment techniques to students' ability levels, learning styles, and interests, teachers ensure that each student can thrive in a learning environment suited to their needs. In marine engineering English education, where learners often hail from diverse cultural backgrounds, educators can employ differentiated instruction to great effect. The advantage of this approach is its ability to effectively cater to the individual needs of students, fostering their learning progress and self-confidence. However, implementing differentiated instruction may necessitate additional time and resources, as well as a deep understanding of students and the teacher's capacity to adapt flexibly to their needs [84-87].

5. Limitations & Challenge

The review suggests significant promise in leveraging TESOL, an educational technology, for marine engineering English education. As shown in Figure 7. However, it also highlights persistent shortcomings within this domain.

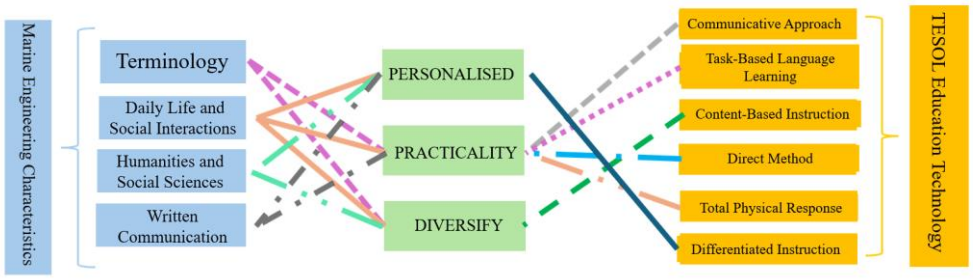

Figure. 7. The link between TESOL educational technology and the characteristics of English for marine engineering.

(1) Expertise: The field of marine engineering demands a high level of specialization, necessitating students to grasp a diverse array of terminology and concepts. Traditional TESOL education techniques may prove inadequate for addressing this specialized need, as they primarily concentrate on general English language instruction.

(2) Lack of teaching resources: The majority of existing teaching materials and resources for marine engineering English are tailored to conventional teaching methods, creating a dearth of materials compatible with TESOL educational technology. This scarcity heightens the challenge for teachers seeking to integrate TESOL technology into marine engineering English education.

(3) Difficulty of technical implementation: TESOL educational technology encompasses a diverse range of pedagogical methods and tools, including multimedia, online, and interactive teaching modalities. Effective implementation of these technologies necessitates adequate hardware and software support, along with technical training and

guidance for teachers. In practice, challenges such as difficulty in deploying the technologies and inconsistent outcomes may arise.

(4) Difficulty in educator development: The field of marine engineering demands educators with a dual proficiency in both marine engineering technology and TESOL education techniques. However, individuals possessing such a unique blend of expertise may be relatively rare, resulting in challenges in training such teachers.

6. Suggestions and prospective

Traditional TESOL educational techniques may not fully address the specific requirements of English language education in the field of marine engineering. As a result, this paper proposes the following recommendations and outlook for future development.

(1) Specialised teaching materials development: To better cater to the learning needs of students in marine engineering, it is imperative to develop or curate English teaching materials tailored specifically for this field. These materials should encompass a rich array of terminology, case studies, technical literature, and other relevant content pertinent to marine engineering. By providing such specialized resources, students can acquire the necessary language skills and domain knowledge to seamlessly integrate into the professional sphere more rapidly.

(2) Industry Expert Participation: The course design and teaching process in marine engineering English education should actively involve experts or practitioners from the field. These professionals can offer invaluable insights by sharing real-life examples, experiences, and industry trends. Their involvement enables students to develop a deeper understanding of industry characteristics and practices, enhancing their ability to apply language skills in relevant contexts.

(3) Enhanced technology application and updating: It’s essential to stay abreast of the latest developments in educational technology and incorporate cutting-edge teaching tools into marine engineering English education. This includes leveraging intelligent teaching platforms and virtual reality technology to enhance learning experiences. Moreover, teachers should be encouraged to engage in research on technology application, exploring innovative approaches suitable for marine engineering English education. This proactive approach ensures that students benefit from state-of-the-art teaching methods and stay aligned with industry advancements.

(4) Intercultural Communication Skills Development: To meet the demands of international cooperation in the field of marine engineering, it's crucial to focus on cultivating students' intercultural communicative competence within their English education. This involves exploring teaching methods and strategies specifically tailored to the cross-cultural context of marine engineering. By studying these aspects, educators can develop effective approaches for enhancing students' ability to communicate and collaborate across cultural boundaries, thus preparing them for successful engagement in global maritime endeavors.

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