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A Needs Analysis for Web-based English Medical Terminology Learning for Healthcare Practitioners: Insights from Quantitative and Qualitative Data

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ABSTRACT

English has become the dominant language in science and medicine, and proficiency in English medical terminology is essential for international communication, academic competence, and professional development. Despite ongoing national efforts to promote the internationalisation of medical education in China, healthcare practitioners continue to face significant barriers in learning English medical terminology, including linguistic complexity, limited resources, and time constraints. This study investigates the specific needs of Chinese healthcare practitioners to improve the efficiency of learning English medical terminology through a web-based learning resource (WBLR). Drawing on the needs analysis framework of Dudley-Evans and St John and adopting a mixed-methods design, the study analysed 417 valid questionnaires and conducted interviews with 22 stakeholders across 6 hospitals. The findings indicate that practitioners consider English medical terminology critical to academic and professional growth, yet face persistent challenges due to the scarcity of interactive, contextually relevant materials. Participants expressed strong preferences for bilingual, multimodal, and technology-enhanced learning, supported by adequate digital competence and reliable online access. Additionally, variations across educational levels highlight the need for instructional designs that accommodate diverse learner profiles. The study suggests that developing tiered, learner-centred, and context-responsive WBLR is essential to enhance the effectiveness and inclusivity of English medical learning.

Keywords: *English for specific purpose, Medical terminology, Healthcare practitioner, Web-based learning resource*

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INTRODUCTION

As medical education and professional exchange become increasingly globalised, English has become the dominant language in science and healthcare (1, 2). Proficiency in English medical terminology has therefore become a core professional competence for healthcare practitioners (3). It facilitates international academic collaboration, supports the accurate transmission of medical knowledge, and enhances communication efficiency and patient safety in multicultural contexts (4). A precise understanding and application of medical terminology are essential for ensuring accuracy in academic research and clinical practice and for aligning with global medical standards (5).

However, many healthcare practitioners still face substantial challenges in learning and using English medical terminology (6). These difficulties stem primarily from linguistic complexity, limited study time, and a lack of context-based, professionally relevant learning resources (7, 8). Traditional instruction often relies on textbooks and rote memorisation, offering minimal interaction and flexibility, which makes it unsuitable for the autonomous learning needs of practising clinicians (9). In response to these challenges, the theoretical framework of English for Specific Purposes (ESP) provides a robust pedagogical foundation for specialised language education. Mathis et al. (5) noted that ESP has evolved into a specialised instructional approach that integrates contextualised, task-based learning to align language acquisition with professional practice, thereby enhancing both instructional relevance and clinical applicability.

In recent years, web-based learning resource (WBLR) has become increasingly significant in ESP education (10). Through the integration of multimedia components and context-based instructional design, WBLR offers healthcare professionals flexible and self-directed learning opportunities that transcend the temporal and spatial constraints of conventional classrooms (11). Empirical studies indicate that such resources enhance the retention of medical English and foster intercultural communicative competence (12). Nevertheless, many existing medical English WBLRs remain limited by low interactivity, limited content diversity, and inadequate personalisation (13), thereby reducing their effectiveness in addressing learners' diverse, practice-oriented needs.

In China, these challenges are particularly evident. Around 70% of English medical terminology is derived from Greek and 25% from Latin (7). Their morphological and phonetic systems differ substantially from those of Chinese, making learning more difficult. Heavy clinical workloads and limited study time further restrict healthcare practitioners' opportunities for systematic learning (14). Moreover, the dominance of Mandarin in clinical practice limits exposure to English, leaving many practitioners' understanding of English medical terminology at a passive recognition level (9). Medical English education in China also continues to rely heavily on conventional classroom instruction, characterised by low interactivity, fragmented curricula (15, 16), and a shortage of instructors with both linguistic and medical expertise. Meanwhile, the development of web-based medical English resources remains in its early stages. Existing platforms predominantly use lecture-style videos, lack authentic clinical contexts and adaptive feedback, and fail to achieve learner-centered and task-oriented instructional goals (17).

To systematically address these challenges, this study adopts the need analysis (NA) framework as its theoretical foundation. As a central component of ESP research, NA ensures that instructional design is grounded in learners' linguistic goals and authentic communicative contexts (18). The framework comprises four dimensions: (a) target situation analysis (TSA) emphasises the importance of learning English medical terminology for

learners; (b) present situation analysis (PSA) examines learners' current proficiency levels and the specific challenges encountered during the acquisition and application of medical terminology; (c) learning situation analysis (LSA) explores learners' preferences, strategies, and motivational orientations, with particular attention to input types and learning modes; and (d) means situation analysis (MSA) assesses the technological infrastructure, digital literacy, and institutional support required for effective engagement with WBLR.

Guided by this framework, the present study examines the linguistic needs of Chinese healthcare practitioners in learning English medical terminology. The findings across these four dimensions provide an empirical basis for the evidence-informed design and development of a WBLR on learning English medical terminology. This study focused on two research questions:

- a. What are the learning needs of healthcare practitioners in learning English medical terminology?
- b. How do healthcare practitioners' learning needs vary across different educational backgrounds?

MATERIALS AND METHODS

Setting

The study was conducted in two sequential phases. First, the NA questionnaire and semi-structured interviews were designed to capture both broad trends and in-depth perspectives from the participants. For the NA questionnaire, participants were recruited using purposive sampling. The selection criteria were: (a) currently working in a medical-related profession; (b) holding a valid medical practitioner's license; (c) having passed the CET-4 (College English Test); and (d) voluntarily agreeing to participate in the study. To ensure the validity of the questionnaire data, all responses were rigorously screened. A total of 438 questionnaires were distributed, and 417 valid responses were screened for the final analysis.

For the interview, four stakeholder groups were purposively selected to ensure representation across hierarchical levels: three administrators; five individuals with doctoral degrees (MDs); six with master's degrees; and eight with bachelor's degrees. Trust was fostered through sustained engagement and informal interactions with participants.

Anonymity was maintained by assigning coded labels: administrators were labelled 'A'; healthcare practitioners holding MDs were labelled 'P-MD'; those with master's degrees were labelled 'P-MS'; and those with bachelor's degrees were labelled 'P-BL', followed by sequential numbers 1 to 8. Gender and departmental balance were also considered in the selection strategy, thereby enhancing the reliability of the findings.

Instrument

The questionnaire was designed using the NA framework (18) and incorporated four dimensions such as TSA, PSA, LSA, and MSA. It consisted of 43 items adapted from Faisal and Said (19) and supplemented with researcher-developed items addressing specific linguistic needs. A 4-point Likert scale was used to minimise neutral responses and encourage more decisive feedback. The interview questions were designed for four stakeholder groups

including administrators and healthcare practitioners with bachelor's, master's, or MD degrees. These questions addressed their needs and perceptions regarding WBLR in English medical terminology.

Instrument validity was confirmed through expert review. Six experts from three disciplines (two in web-based resource development, two healthcare professionals, and two linguists) assessed the instrument's face and content validity. Their feedback prompted refinements in question phrasing and the inclusion of additional items. A pilot study involving 40 purposively selected healthcare practitioners further tested the questionnaire, leading to minor adjustments. The internal consistency of the questionnaire was assessed using Cronbach's alpha. In the pilot study, all subscales showed good internal consistency ($\alpha = 0.861$ – 0.914). In the formal analysis, reliability further improved across all subscales ($\alpha = 0.892$ – 0.944), with an overall Cronbach's alpha of 0.954, indicating excellent internal consistency (Table 1). For the semi-structured interviews, reliability was ensured through member checking, in which participants reviewed their transcripts for accuracy and confirmed the contents.

Table 1: Reliability and descriptive statistics of the questionnaire

Construct	Items	Cronbach's alpha (pilot study)	Cronbach's alpha (formal study)	Mean	SD
Target situation analysis (TSA)	5	0.886	0.921	3.48	0.62
Present situation analysis (PSA)	10	0.914	0.892	3.20	0.66
Learning situation analysis (LSA)	13	0.861	0.912	3.13	0.67
Means situation analysis (MSA)	11	0.909	0.944	3.34	0.60
Overall	39	–	0.954	3.25	0.64

Data Analysis

The NA questionnaires were administered in 6 hospitals in China, with 30 minutes allotted for completion to enhance participant engagement. The NA questionnaire data were analysed using Statistical Package for the Social Science (SPSS). Descriptive statistics were computed to summarise participant responses, including frequencies, means, standard deviations, and percentages. The Kruskal–Wallis test, a non-parametric method suitable for unequal group sizes and non-normal distributions, was applied to compare responses across educational levels. A significance threshold of $p < 0.05$ was used for all statistical tests to validate the findings and ensure rigour. Finally, interview insights were integrated with the questionnaire results to provide a comprehensive understanding of stakeholders' needs in learning English medical terminology.

Semi-structured interviews were conducted online with stakeholders, each lasting approximately one hour to accommodate participants' availability. A core set of questions was prepared, with follow-up questions added as needed to ensure comprehensive data collection. Interviews were translated into English as required and transcribed verbatim. Thematic analysis was used to analyse the interview data. Detailed notes supported coding

and theme development. The first author's initial coding was reviewed by the second to enhance reliability, with discrepancies resolved through discussion. A comparative analysis was then conducted to integrate interview and questionnaire findings, providing a comprehensive understanding of the identified needs.

RESULTS

Demographic Information

A total of 417 valid survey responses were obtained after rigorous screening. The majority of respondents were aged under 35 (44.6%), followed by those aged from 36 to 45 (39.8%), and those over 45 (15.6%). In terms of educational qualifications, 66.9% of participants held a bachelor's degree, 25.4% a master's, and 10.3% a doctorate (Table 2).

Table 2: Demographic information of the participants in the needs analysis survey

Items	Demographic information	n	%
Age	<35 years old	186	44.60
	36 to 45 years old	166	39.81
	Above 45 years old	65	15.59
	Bachelor's degree	279	66.91
Highest academic qualification	Master's degree	106	25.42
	Doctor of Medicine (MD)	43	10.31

The Overall Trend of the Needs in Learning English Medical Terminology

A significant proportion of the participants acknowledged the importance of English medical terminology in their professional development (Table 1). High mean scores across all TSA items ($M = 3.44$ – 3.56) indicate strong agreement that such terminology is essential for understanding medical texts (TSA1: $M = 3.50$), improving writing quality (TSA2: $M = 3.44$), and following academic lectures (TSA3: $M = 3.56$). Similarly, it was regarded as beneficial for workplace performance (TSA4: $M = 3.44$) and enhancing overall English proficiency for career advancement (TSA5: $M = 3.48$). The low standard deviations ($SD = 0.57$ – 0.67) reflect consistent perceptions among participants.

Respondents reported substantial difficulties related to limited medical vocabulary. Language-use challenges were evident in writing, listening, and speaking tasks (e.g., PSA3 and PSA5: both $M = 3.35$ – 3.40), indicating high cognitive load during professional communication. Items related to learning methods further revealed dissatisfaction with current materials: 97.6% found textbook-only instruction inadequate (PSA7: $M = 3.41$), and 87.5% described their learning process as unengaging (PSA10: $M = 3.17$). The lowest means (PSA8: $M = 2.81$) reflected limited use of supplementary resources. Standard deviations ($SD = 0.55$ – 0.84) suggest moderate variability in learner experience.

Learners showed strong preferences for multimedia and bilingual learning. The most favoured input was bilingual textbooks (LSA9: $M = 3.68$), followed by contextualised sample sentences (LSA8: $M = 3.17$) and video-based learning (LSA3: $M = 3.29$). While learners valued pronunciation and definitions, they showed less interest in spelling practice (LSA6: $M =$

2.90). Preferences for web-based platforms over traditional books were also evident (e.g., LSA13: $M = 3.08$). Overall, responses showed moderate variation ($SD = 0.47\text{--}0.77$), reflecting diverse learning habits and preferences.

Most participants possessed sufficient access to digital infrastructure and skills to support web-based learning. Nearly all had access to devices (MSA1: $M = 3.40$) and internet (MSA2: $M = 3.39$), and over 95% reported confidence in navigating online content (MSA6: $M = 3.41$). However, a slightly lower score for device use in the workplace (MSA3: $M = 3.22$) suggests practical constraints. Participants expressed high readiness to adopt WBLR, valuing flexibility and convenience (MSA9–11: $M = 3.33\text{--}3.37$). The narrow SD range ($0.54\text{--}0.72$) indicates shared digital competence among respondents.

Comparing the Results Across Education Levels

The questionnaire results were analysed by educational level, encompassing bachelor's degree holders ($n = 279$), master's holders ($n = 103$), and MD holders ($n = 35$). As shown in Figure 1, significant differences in mean values were observed among educational levels, highlighting variations in practitioners' responses. The Kruskal–Wallis test revealed substantial effects of educational level on 12 items (TSA3–5, PSA6, PSA8, PSA9, LSA4, LSA6, MSA5–8), indicating statistically meaningful variation between groups. Findings from TSA3–5 showed that master's and MD holders consistently scored higher than bachelor's degree holders, with comparable values across all three items. TSA5 results indicated that master's and MD holders recorded the same mean score ($M = 3.67$), while bachelor's holders scored slightly lower ($M = 3.40$), reflecting differences in the perceived usefulness of English medical terminology. Bachelor's degree holders primarily relied on textbooks as their primary learning resource (PSA6, $M = 3.05$), while those with higher degrees used a broader range of materials (PSA8). MD holders reported significantly lower reliance on textbooks than bachelor's holders (PSA8: 2.07 vs. 2.93). PSA9 results showed that satisfaction with existing learning materials was lower among MD holders ($M = 2.4$) and master's holders ($M = 2.94$) compared to bachelor's holders ($M = 3.12$). Bachelor's degree holders placed greater emphasis on mastering the spelling of medical terminology, whereas master's and MD holders showed less interest in this aspect (LSA6). Furthermore, the master's and MD groups demonstrated significantly stronger digital skills, broader resource utilisation, and higher adaptability to online learning and web-based platforms than the bachelor's group (MSA5–8).

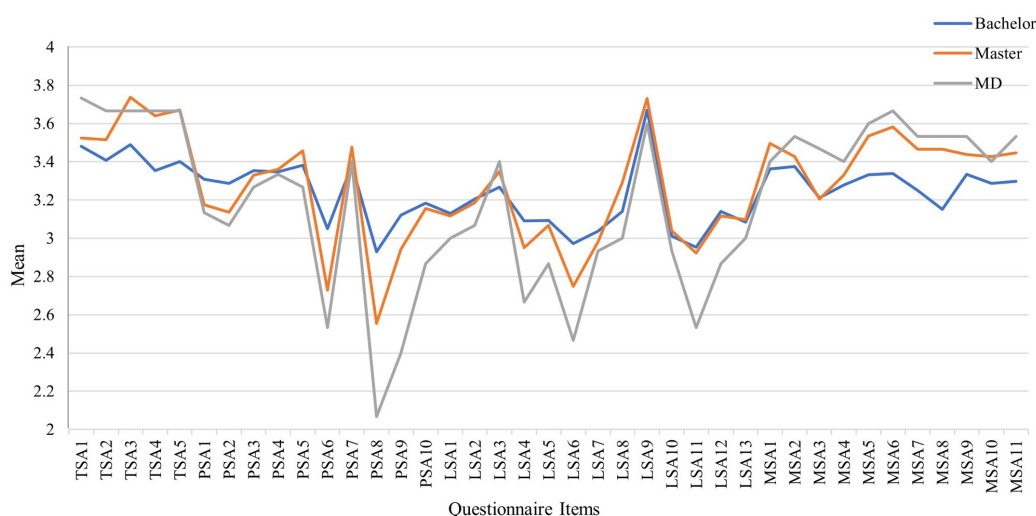


Figure 1: Comparison of mean scores across educational levels.

Semi-Structured Interviews

Interviews reaffirmed the importance of learning English medical terminology for healthcare practitioners in China. Practitioners emphasised their significance for accessing advanced literature, publishing papers, participating in international collaborations, and advancing career opportunities such as professional title assessments, international exchanges, and overseas training. Administrators further highlighted their value in reducing communication errors and enhancing patient safety.

Most hospitals adopted strategies to enhance the acquisition of English medical terminology through policy incentives, practical support, and dedicated resources. Measures included performance-based rewards, advantages in professional title assessment, and access to research funding. Some institutions promoted the use of English in the workplace, for example, during handover sessions. Many created blended support systems that combined online and offline resources, such as platforms like the Medical Terminology Learning WeChat Group and the Medical English Corner. One of the hospitals quoted:

We encouraged healthcare practitioners to complete a six-month full-time medical English programme. Those who passed the final exam were reimbursed for training costs and offered opportunities to teach international students or join overseas exchanges. [A1]

Interview data indicated that healthcare practitioners across educational levels unanimously recognised the importance of English medical terminology, although their practical needs and application contexts varied. Doctoral-level practitioners emphasised their role in international communication, academic research, and teaching international students. As one doctoral practitioner noted:

During the overseas research programme, I was expected to participate in various academic conferences and publish journal articles. After the programme, I was going to be responsible for teaching international medical students. Medical terminology was the foundational skill that underpinned all these tasks. [P-MD1]

Master's-level practitioners emphasised that proficiency in English medical terminology was vital for academic achievement, particularly in the writing and publishing of papers, which were essential prerequisites for doctoral studies and academic career advancement. One master's practitioner shared:

Completing a paper for an SCI-indexed journal was nearly impossible without a solid grasp of English medical terminology, which limited my ability to pursue a doctoral degree and advance my career. [P-MS2]

Bachelor's-level practitioners acknowledged the importance of English medical terminology for professional title evaluations but reported significant challenges in achieving proficiency. One bachelor's-level practitioner shared:

I need to improve my proficiency in English medical terminology to pass the hospital-administered medical English exam, which is delaying my promotion to a professional title compared with my peers. [P-BL5]

Practitioners reported that complex spelling and pronunciation, along with demanding work schedules, limited opportunities for structured learning. Time constraints and financial pressures were also significant barriers. One of the practitioners mentioned:

Medical terminology was intricate and lengthy. I even struggled to remember the name of my own speciality - anaesthesiology. [P-BL3]

Practitioners across different educational levels encountered distinct challenges in mastering medical terminology. Practitioners with bachelor's degrees struggled with spelling, pronunciation, and fundamental memorisation. One bachelor's degree holder shared:

When communicating with professors, I often found it challenging to recall the English medical terminology, which made me worried about missing that critical opportunity to visit Japan. [P-MS4]

Stakeholders unanimously highlight the value of WBLRs for their adaptability and accessibility in meeting healthcare practitioners' specific learning needs. Bilingual resources and practical, case-based materials are identified as critical, particularly for those with demanding work schedules. Respondents note that bilingual support enhances comprehension, especially for conceptual understanding. Practical resources incorporating real-world cases are viewed as better aligned with professional contexts. However, differences in WBLRs' preferences persist across educational levels.

Doctoral-level practitioners generally perceived that existing WBLRs lacked sufficient depth in professional content and systematic organisation, particularly regarding specialised medical terminology. One doctoral practitioner explained:

The resources available for learning specialised terminology could have been much better. I primarily learned that specific terminology while reviewing the literature. [P-MD5]

Master's-level practitioners emphasised the need for design optimisation in WBLRs, noting that monotonous and uninspiring content reduced engagement and learning outcomes. They recommended incorporating diverse video content and interactive terminology games to enhance learning efficiency and engagement. One of the valuable responses stated:

Most online learning resources were unengaging and lacked practical relevance, which made it challenging to apply them in real-world work settings. As a result, I never managed to complete an entire course. [P-MS3]

Bachelor's-level practitioners recognised the potential of WBLRs to improve learning efficiency but reported difficulty locating suitable resources, resulting in continued reliance on traditional learning methods. One of the bachelor's-level practitioners stated:

I reviewed and memorised the surgical terminology in advance to prepare for shift handover in English, because I found it difficult to recall the terms without preparation. [P-BL1]

The essential role of English medical terminology in the professional development of healthcare practitioners was widely recognised, supporting academic research, international collaboration, and healthcare quality improvement. WBLRs, with their flexibility and accessibility, offered significant potential to enhance learning efficiency and address these barriers.

DISCUSSION

Overall Needs for Learning English Medical Terminology

The findings across the four NA dimensions (TSA, PSA, LSA and MSA) collectively highlight the specific learning needs of healthcare practitioners in acquiring English medical terminology. Practitioners recognise its relevance to academic and professional development (TSA) but face persistent difficulties with vocabulary acquisition and limited access to engaging resources (PSA). Their preference for bilingual, multimedia, and web-based materials (LSA), combined with sufficient digital competence (MSA), underscores strong demand for flexible, technology-enhanced learning environments.

The TSA findings indicate that Chinese doctors place high importance on English medical terminology for both academic and professional purposes. Mastery of terminology is regarded as fundamental to effective reading, writing, listening, and clinical communication. Reading facilitates comprehension and accurate interpretation of medical texts, supporting evidence-based decision-making. In writing, it ensures linguistic precision and academic clarity, aligning with Hutchinson and Waters (20), who argue that ESP instruction should address the linguistic requirements of professional tasks. Likewise, familiarity with terminology enhances listening to comprehension, enabling doctors to follow English-medium lectures, conferences, and online courses that convey the latest medical knowledge (6). Professionally, proficiency in terminology supports clear communication, accurate documentation, and effective collaboration, directly influencing professional development (9). These findings reflect Knowles's (21) adult learning theory, which emphasises that practical goals drive adult learning and that adults prefer learning that enhances real-world performance. Overall, the results suggest that English medical terminology constitutes a core professional competency that links language proficiency to clinical effectiveness and international engagement.

The PSA findings indicate that doctors face significant challenges in learning English medical terminology, primarily due to the limited availability of diverse and engaging learning resources. Most participants rely heavily on textbooks, which they perceive as inadequate for their professional and communicative needs. The lack of supplementary and interactive materials diminishes learner engagement and motivation, particularly among those with higher educational qualifications. These findings align with Zafirovska and Xhaferi (8) and Xu et al. (1), who observed that traditional textbook-based instruction often fails to address the cognitive and contextual demands of learners in specialised fields such as medicine. The present study extends this argument by highlighting the heterogeneous learning needs within the medical community and underscoring the importance of pedagogical designs that incorporate interactivity, contextual relevance, and adaptability. Consequently, future medical terminology learning platforms should employ modular and adaptive designs to accommodate diverse learner profiles and support sustained acquisition and retention of specialised vocabulary.

The LSA findings indicate that doctors strongly prefer multimodal input, structured guidance, and technology-supported learning environments when acquiring English medical terminology. They value integrating videos, images, and text to enhance engagement and create a richer learning experience. Their preference for bilingual, contextualised input aligns with Krashen's (22) Input Hypothesis, which emphasises the importance of comprehensible, meaningful input over rote memorisation. This suggests that semantically explicit, contextually grounded materials can improve both efficiency and retention in terminology learning (23). Regarding learning tools, doctors show a clear inclination towards web- and mobile-based learning, favouring digital exercises and online platforms over traditional textbooks. This preference supports Siemens's (24) connectivism theory, which posits that digital environments foster learner autonomy and the construction of connected knowledge. Overall, these findings underscore the importance of embedding real-world medical contexts, multimodal activities, and flexible digital environments in instructional design. Guided by ESP principles (20), course development should be learner-centred and needs-driven, incorporating multimedia and structured content to build adaptive, effective learning pathways. These insights provide a solid empirical foundation for the ongoing optimisation of WBLR that addresses healthcare professionals' authentic, self-directed learning needs.

The MSA findings indicate that doctors have the necessary technological infrastructure to use WBLR effectively, including reliable access to devices, stable internet connectivity, and adequate digital literacy. Most participants demonstrate competent computer skills, frequent engagement with online learning, and a high level of readiness for technology-supported instruction. These results align with Nami and Asadnia's (25) assertion that digital literacy is essential to the success of technology-enhanced lifelong learning, particularly in healthcare education. Furthermore, participants express a clear preference for flexible, web-based learning environments that allow them to learn anytime and anywhere, an essential consideration for healthcare professionals with irregular working schedules and continuous learning requirements. Guided by Knowles's (21) adult learning theory, WBLR facilitates self-directed learning by accommodating learners' individual needs and pace. From the perspective of connectivism (24), they also extend beyond content delivery to promote interaction, collaboration, and knowledge construction through digital networks. Overall, these findings confirm that doctors are technologically prepared for WBLR adoption and that WBLR's effectiveness relies on maintaining flexibility, accessibility, and professional relevance within medical learning contexts.

Variations in the Needs for Learning English Medical Terminology Across Education Levels

This study highlights notable differences in healthcare practitioners' learning needs for English medical terminology, which are influenced primarily by their educational backgrounds. While all participants agree on the importance of mastering medical terminology, their focus and depth of learning needs vary significantly. Practitioners with higher qualifications tend to show more advanced, specialised, and purpose-driven learning behaviours, whereas those with lower qualifications prioritise basic skills and structured guidance.

Practitioners holding a bachelor's degree primarily focus on developing essential communication and language skills, such as using English during clinical handovers and improving pronunciation and spelling. Due to limited exposure to international communication and academic discourse, they often rely on traditional, textbook-based learning. This group benefits most from explicit, accessible materials and structured instructional support. However, inadequate online learning experience and difficulty accessing suitable resources may limit their active engagement in professional development (11).

In contrast, practitioners with master's or doctoral degrees display more complex, self-directed learning patterns. They favour interactive and contextualised materials, especially those based on real cases and professional scenarios that promote clinical reasoning, academic writing, and international collaboration. Their preference indicates a strong desire for autonomy, problem-solving, and practical application, aligning with Knowles's (21) adult learning theory, which emphasises goal-oriented and practice-based engagement. This group also shows greater digital skills and online learning experience, allowing them to use fragmented time effectively for independent study. Nonetheless, they are critical of existing resources, particularly regarding their limited professional depth and lack of specialised content.

Limitations

This study has certain limitations. The participants were drawn from a limited number of regions in China, which may limit the generalisability of the findings. Regional differences in healthcare systems, educational opportunities, and levels of international engagement may influence practitioners' learning needs and experiences with English medical terminology. Future research should include participants from a broader range of geographic and institutional settings to improve representativeness and strengthen external validity.

CONCLUSION

In conclusion, healthcare practitioners recognise the critical importance of learning English medical terminology. Nevertheless, they continue to encounter challenges arising from the limited availability of interactive and contextualised learning resources. The findings further reveal a strong preference for multimodal, bilingual, and technology-enhanced approaches. Moreover, participants demonstrate adequate technological infrastructure and digital competence to support the effective use of WBLR, indicating favourable conditions for adopting such platforms in medical terminology learning. These results also suggest

that differences across educational levels should be carefully considered when designing learning resources to accommodate varying degrees of professional maturity and learner autonomy.

The variations across educational levels suggest that resource design should carefully address learners' differing degrees of professional development and autonomy. Accordingly, when developing WBLR for learning English medical terminology, it is crucial to balance accessibility and disciplinary depth to meet learners' diverse needs. Instructional materials should provide structured scaffolding for foundational learners to strengthen core language and communication competencies, while offering advanced learners interactive, context-rich content that fosters both professional and academic advancement. Overall, this study underscores that creating learner-centred and context-responsive WBLR integrating multimedia and bilingual support is essential for improving the effectiveness and sustainability of medical English learning.

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ETHICAL APPROVAL

This study was approved by the Medical Ethics Committee of the General Hospital of Ningxia Medical University, China (IRB Approval No. KYLL-2025-1279). All participants were fully informed of the study's objectives and procedures and provided written informed consent before participation. All collected data were anonymised and treated with strict confidentiality throughout the research process.

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