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Research on the Construction of a Smart Learning Resource Library for English Education in Higher Vocational Colleges Based on Knowledge Graphs

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Abstract: Against the backdrop of digital transformation in vocational education, standardized English teaching resources struggle to accommodate the diverse learning needs of higher vocational students. Existing English resource libraries suffer from issues such as poor knowledge coherence, inadequate matching accuracy, and a lack of intelligent recommendation mechanisms. By leveraging knowledge graphs to construct a hierarchical knowledge framework, integrating tiered teaching resources, establishing a graph-driven intelligent recommendation system, and employing collaborative filtering similarity algorithms for personalized resource matching, this approach enables comprehensive knowledge organization, enhances resource adaptation at different levels, and facilitates automated content delivery. The implementation of this integrated knowledge architecture, tiered resource configuration, and automated recommendation system helps clarify course knowledge logic, reduces English comprehension barriers, expands online self-directed learning pathways, and provides robust technical support for digitalized, personalized English instruction in higher vocational education.

Keywords: Knowledge graph; Higher vocational English; Smart learning resource repository; Personalized resource recommendation; Digitalization of vocational education

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1. Introduction

Digital teaching is gradually permeating English classrooms in higher vocational education. Standardized static teaching materials struggle to meet students' differentiated learning needs, while a vast number of instructional resources remain fragmented and underutilized, failing to fully realize the potential of tiered learning guidance. Leveraging their network-based correlation modeling capabilities, knowledge graphs can

reconstruct the inherent logic of linguistic knowledge, offering a new approach for developing intelligent resource repositories. To address issues such as gaps in knowledge connectivity, imbalances in learning adaptation, and deficiencies in intelligent recommendation systems, the application of graph technology enables the establishment of standardized knowledge frameworks and integrated recommendation mechanisms, thereby transforming the provision model for vocational English resources and facilitating the implementation of personalized autonomous learning in professional English education.

2. Basic explanation for building a smart learning resource library for English in higher vocational education based on knowledge graphs

2.1. The practical foundations for the development of digital English teaching in higher vocational education

The digital transformation of vocational education continues to advance, with online teaching platforms becoming standard auxiliary tools for daily English instruction in higher vocational institutions. The limitations of traditional centralized resource distribution models have become increasingly apparent. Vocational students exhibit significant variations in their English proficiency levels and knowledge mastery within each group; one-on-one offline tutoring by instructors struggles to cater to all learners, while standardized course materials, exercises, and audio resources fail to accommodate individualized learning rhythms. Uniformly distributed learning content in offline classrooms only serves intermediate learners, leaving both foundational learners and high-achieving students without access to tailored materials. Digital teaching platforms therefore urgently require resource platforms capable of autonomous selection and precise content delivery, making the adoption of structured data models to optimize resource provision an essential industry requirement.

2.2. The intrinsic value of knowledge graphs in enhancing the development of language learning resources

Knowledge graphs treat knowledge points as independent nodes and construct a multi-level, networked knowledge structure using associated edges. This approach effectively breaks down the fragmented nature of learning components such as English vocabulary, grammar, and reading/writing practice, transforming previously scattered teaching materials into a cohesive knowledge system with logical connections [1]. Utilizing the triple entity mapping model enables standardized association of knowledge point attributes, labels, and supporting resources; spatial transformation algorithms quantify the degree of relevance between different knowledge elements. Compared to databases storing single texts, this technology clearly distinguishes prerequisite knowledge, subsequent extension knowledge, and similar content, providing fundamental technical support for intelligent matching tailored to learners' needs and automated generation of personalized learning paths.

2.3. Current status of existing smart learning resources for English in higher vocational education

Current higher vocational colleges have accumulated a substantial collection of English teaching materials covering various types such as knowledge point texts, supplementary exercises, extended reading materials, and audio listening resources. All these resources are equipped with basic metadata, including classification

labels, knowledge series affiliations, and source information, with the total number of resources exceeding one thousand. Most existing resources are stored in separate tables where only basic information has been entered; logical connections between knowledge points have not yet been established. The resource library merely provides fundamental search and storage capabilities, lacks automatic identification of sequential relationships between knowledge points, and does not incorporate intelligent matching modules tailored to students' learning needs. Consequently, this extensive resource repository fails to deliver practical benefits in implementing tiered teaching approaches or supporting self-directed learning.

3. Deficiencies in the construction of the association system for English resource knowledge graphs in higher vocational education

3.1. There are gaps in establishing the hierarchical logical relationships between English knowledge points

Current English learning resources only achieve basic entry of knowledge points, tags, and supporting materials, without establishing a well-structured hierarchical framework; various knowledge entities remain fragmented over time. Most resource databases label individual knowledge points without distinguishing semantic relationships between prerequisite foundations, subsequent extensions, or related concepts, making it difficult to form coherent knowledge chains. The absence of standardized triplet entity mapping specifications results in unclear boundaries between knowledge connections across modules, preventing the use of spatial transformation functions to quantify knowledge relevance or automatically generate systematic learning paths. Isolated knowledge nodes cannot be integrated into a networked system, hindering students from accessing interconnected knowledge when searching for specific content, impairing the intuitive presentation of complete course structures, and limiting the full realization of the core value of layered learning guidance and personalized instructional support in resource libraries.

3.2. The content of educational resources is not adequately aligned with the English learning needs of vocational college students

Traditional resource distribution adopts a uniform approach that fails to account for individual differences in students' mastery of knowledge points, making it inadequate for addressing the distinct English learning needs within vocational education communities. Resource libraries merely organize materials by knowledge categories without implementing tiered classification based on students' proficiency levels; they lack specialized supporting materials for weaker areas and fail to provide advanced content tailored for high-achieving learners [2]. Conventional resource allocation does not utilize similarity analysis for personalized matching but relies solely on manual student selection, which makes it difficult for beginners to identify appropriate introductory materials while causing advanced learners to waste time revisiting already mastered concepts. This approach fails to meet the diverse needs of students at different proficiency levels, significantly reducing resource utilization efficiency.

3.3. The supporting system for intelligent resource recommendation driven by mapping technologies has not yet been fully established

Most educational institutions' English resource repositories only implement basic data storage modules and have not yet established a comprehensive architecture required for integrating knowledge graphs with

intelligent recommendation systems. Functional modules such as resource management, user management, and algorithm training remain isolated from each other, lacking interoperable data interfaces. There is no algorithmic support for collaborative filtering similarity calculations, making it impossible to quantify the alignment between students' learning needs and available resources; standardized matching thresholds are also absent as a basis for recommendation decisions. No integration exists among front-end presentation interfaces, algorithmic processing, and underlying databases, hindering automatic selection of suitable materials based on student historical data. Only keyword search functionality remains available, preventing the generation of personalized recommendation lists. Consequently, the networked framework built through knowledge graphs struggles to be transformed into student-oriented autonomous learning services.

4. Implementation path for building the association system of knowledge graphs for English resources in higher vocational education

4.1. Organize the hierarchical structure of English knowledge points in higher vocational education to establish a comprehensive and interconnected framework

The entire teaching knowledge framework of vocational English education is systematically organized around core entities, categorized into three tiers—basic prerequisites, key challenges, and extended modules—based on instructional sequence. Each knowledge category receives dedicated standardized labels that enable identification of related content through entity attributes, thereby establishing intrinsic connections between vocabulary, grammar, reading/writing, and listening/speaking modules. A unified data entry format standardizes all knowledge entries for foundational storage in databases. Knowledge mapping relationships are constructed using ternary (h, r, t) entity representation rules, with spatial transformation functions quantifying correlation strengths between nodes to build a multi-dimensional networked knowledge graph. This graph's internal relationship mechanisms automatically generate structured learning pathways, clearly marking prerequisite foundations and subsequent extensions for each concept, eliminating logical gaps caused by fragmented storage. This creates a comprehensive, hierarchically organized knowledge architecture that supports precise resource matching. Furthermore, knowledge points should serve as the fundamental building blocks for resource graph construction. When creating links for a knowledge point, its labels should be defined first, followed by generation of associated content based on these attributes. Standardized knowledge entries are then stored in databases, forming a robust teaching resource repository for vocational English education.

4.2. Hierarchical and categorized integration of English resources to meet the learning needs of vocational college students

Building upon the established hierarchical framework for English knowledge, educators systematically reorganize and integrate existing teaching resources. Using knowledge point labels as the classification basis, educators link various resources—including exercises, listening materials, reading texts, and practical cases—to corresponding knowledge nodes, categorizing them into three levels: foundational consolidation, skill enhancement, and advanced expansion tailored to students' learning capabilities. To address individual differences in knowledge acquisition, we employ collaborative filtering similarity calculations to establish resource matching criteria, using learners' mastery levels of each knowledge point as the core evaluation parameter to quantitatively assess how well available resources align with actual student needs. Moving

beyond traditional uniform distribution approaches, the system automatically identifies suitable resource ranges based on learning profiles—delivering introductory materials targeted at weaker learners and advanced training content for high-performing students. This approach transforms vast resource inventories from disorganized collections into precisely tailored solutions that meet diverse learning needs, significantly enhancing the practical value of educational resources.

4.3. Establish a comprehensive operational framework for intelligent resource distribution based on graph-based integration

The system adopts a three-tier integrated operational architecture to establish a seamless connection between knowledge graphs and intelligent content delivery. The foundational layer utilizes standardized databases for storing knowledge points and supporting resources; the middle layer comprises four modules: resource management, user management, model training, and algorithm services; while the top layer features a student-oriented interface that enables real-time data interoperability across the entire process. By incorporating a collaborative filtering similarity calculation model with predefined matching thresholds for content recommendation, the system automatically analyzes students' historical learning data and knowledge mastery levels. Content delivery is triggered when similarity scores exceed specified thresholds [3]. Leveraging the knowledge graph's built-in similarity-based resource matching and associated learning pathways, the system synchronously delivers supplementary materials related to identified knowledge points, creating a comprehensive self-directed learning ecosystem. This framework transforms static knowledge graphs into dynamic recommendation services, overcoming the limitations of traditional resource libraries that only support manual searches, thereby continuously expanding online learning opportunities for students. By integrating multi-series and multi-tagged knowledge points into a unified knowledge graph database, the system employs recommendation algorithms to establish personalized connections between educational resources and individual learners, enabling tailored content suggestions.

5. Implementation results of the knowledge graph association system for higher vocational English resources

5.1. Establish a comprehensive English knowledge framework that clarifies the logical progression of course content

Leveraging a hierarchically organized multi-dimensional English knowledge graph, fragmented knowledge points are structured into an orderly network through triplet entity mapping rules. Each knowledge node clearly distinguishes its foundational context, core content, and extended details, establishing a coherent curriculum framework for vocational English that spans from basic vocabulary and grammar to comprehensive reading and writing practice. Unified standardized tags integrate content across listening, speaking, reading, and writing modules, eliminating knowledge fragmentation between teaching units. An integrated spatial transformation algorithm quantifies knowledge correlations and automatically generates progressive learning pathways. When accessing specific knowledge nodes, learners can simultaneously access related preceding and subsequent content, swiftly identifying various semantic relationships—including hierarchical progression, parallel connections, and supplementary information. This addresses the challenge of fragmented learning hindering holistic understanding, establishes a systematic English knowledge framework, and provides a comprehensive reference for layered instructional design.

5.2. Tailored, categorized resources that suit students' learning needs, reducing the difficulty of English comprehension

By leveraging the hierarchical framework of knowledge graphs, all teaching resources are systematically categorized and linked into three tiers: foundational consolidation, skill enhancement, and advanced expansion. Each resource type precisely targets student groups at distinct proficiency levels, with matching algorithms based on collaborative filtering similarity analysis to align with actual learning needs. Students with weak foundations can access simplified explanations and basic exercises to avoid complex content beyond their cognitive capacity, thereby reducing comprehension barriers; those with intermediate skills benefit from comprehensive practice materials and situational dialogue resources for gradual skill progression; while advanced learners can access sophisticated reading materials and workplace English extension resources [4]. This tiered approach accurately matches students' existing knowledge bases, prevents uneven learning thresholds caused by uniform instructional models, gradually breaks down complex concepts through gradient design, and significantly reduces overall knowledge absorption and comprehension difficulty.

5.3. The intelligent recommendation system for learning maps expands channels for self-directed learning

The three-tier integrated operational architecture connects the knowledge graph database, algorithmic model services, and front-end display interfaces. Leveraging collaborative filtering similarity calculations, it automatically matches student learning profiles with educational resources, employing standardized matching thresholds to enable automated targeted resource delivery—overcoming the limitations of traditional resource libraries that rely solely on manual keyword searches. The system analyzes students' daily learning behaviors and knowledge acquisition data, then synchronously provides supplementary materials through the graph's internal similarity mechanisms and associated learning pathways, creating a continuous closed-loop supply of self-directed learning resources. Students are no longer constrained by classroom schedules or offline teaching timelines; they can access content tailored to their specific weaknesses at any time and independently design personalized learning paths. Even fragmented moments can be utilized for targeted English practice, significantly enriching online self-learning scenarios and comprehensively expanding effective after-class learning opportunities for vocational college students.

6. Conclusion

Knowledge graph technology can transform the development methodology for intelligent English learning resource repositories in higher vocational education. A comprehensive hierarchical framework helps clarify course structure, while tiered resource configurations cater to diverse learner needs. The graph-driven recommendation system further expands online self-directed learning opportunities. This approach addresses practical challenges such as disorganized knowledge connections, inadequate resource alignment, and insufficient intelligent recommendation mechanisms, achieving precise matching of learning materials through collaborative filtering algorithms. The entire development framework provides a viable solution for digital resource provision in higher vocational English education, facilitates tiered personalized teaching implementation, and offers standardized guidelines for building similar language-based intelligent resource repositories.

Disclosure statement

The author declares no conflict of interest.

References

[1] Nie L, 2025, Research on the Development of English Teaching Resource Libraries for Higher Vocational Colleges in a Digital Environment. Overseas English, 2025(19): 203–205.

[2] Fu ZY, 2023, Exploration of Approaches to Building English Teaching Resource Libraries in Higher Vocational Education under the Digital Era. Huazhang, 2023(8): 31–33.

[3] Guo F, 2023, Design of a Knowledge Graph-Based Recommendation System for English Teaching Resources in Higher Vocational Education. Information and Computer (Theoretical Edition), 2023(9): 232–234.

[4] Wu JQ, 2022, Construction and Application of an English Teaching Resource Database in Higher Vocational Colleges. Journal of Taiyuan City Polytechnic, 2022(6): 149–152.