



OPEN ACCESS

EDITED BY

Wu Ping,
Beijing Language and Culture University,
China

REVIEWED BY

Yi Yan,
China University of Petroleum, Beijing, China
Paisan Sukjairungwattana,
Mahidol University, Thailand

*CORRESPONDENCE

Haiyang Hu
✉ 429359152sea@gmail.com
Fan Li
✉ lifan94723@gmail.com

RECEIVED 13 February 2024

ACCEPTED 28 May 2024

PUBLISHED 21 June 2024

CITATION

Hu H, Li F and Luo Z (2024) The evolution of
China's English education policy and
challenges in higher education: analysis
based on LDA and Word2Vec.
Front. Educ. 9:1385602.
doi: 10.3389/feduc.2024.1385602

COPYRIGHT

© 2024 Hu, Li and Luo. This is an
open-access article distributed under the
terms of the [Creative Commons Attribution
License \(CC BY\)](#). The use, distribution or
reproduction in other forums is permitted,
provided the original author(s) and the
copyright owner(s) are credited and that the
original publication in this journal is cited, in
accordance with accepted academic
practice. No use, distribution or reproduction
is permitted which does not comply with
these terms.

The evolution of China's English education policy and challenges in higher education: analysis based on LDA and Word2Vec

Haiyang Hu^{1*}, Fan Li^{2*} and Zhengying Luo³

¹Faculty of Business, Macao Polytechnic University, Macao, Macao SAR, China, ²Foreign Languages School, Weifang University of Science and Technology, Weifang, China, ³Faculty of Humanities and Social Sciences, City University of Macau, Macao, Macao SAR, China

China proposed the Belt and Road Initiative to strengthen regional connectivity so as to embrace a brighter future together. Since the Initiative was put forward, it has brought many challenges to China's English education policy. By employing Latent Dirichlet Allocation (LDA) and Word2Vec, this study analyzes the evolution of topics and challenges in China's English education policy under the Belt and Road Initiative. The results indicate that after the initiative, the policy focus has changed. English education has shifted from testing abilities to cultivating students' intercultural communication skills in order to meet the needs with countries alongside the "Belt and Road". Moreover, teaching strategies that were examination-oriented have also changed to emphasizing teaching methods and feedback. The focus and teaching strategies have also undergone great changes. China's English education policy has shifted from focusing on improving students' writing skills, English proficiency, and creativity to conducting in-depth research and addressing specific issues, including challenges in linguistics, media influence, educational institutions and programs, online courses, attitudes and self-efficacy, use of multiple languages and globalization, teaching issues, and curriculum design. These findings shed light on how the Belt and Road Initiative changed China's English education policy and provide further directions for future research.

KEYWORDS

China's English education policy, the Belt and Road Initiative, challenges, higher education, LDA, Word2Vec

1 Introduction

The research on English education policy in Chinese higher education can be traced back to the Reform and Opening up (Cheng and Wang, 2012). Guo (2013) indicated that English has become an essential part since then because China began to transform from planned economy to market economy. China's English education policies in higher education have shifted from emphasis on skills to communication abilities. This change reflects the characteristic of China's English education policies being constantly adjusted with the changes in social demands. Therefore, it needs to be understood within the context since the Reform and Opening Up. However, Mavroidis and Sapir (2019) indicated that since the 21st century, especially in 2005, China joined the WTO's Government Procurement Agreement, which promoted the liberalization of international trade and investment; China actively participated in and promoted the Asia-Pacific Economic Cooperation (APEC), including in the fields of

economy, trade, investment, science and technology. At that time, English was not only an important communication tool, but also occupied a crucial position in trade, finance, technology and diplomacy (Hu and Lei, 2014). In addition, China has also strengthened cooperation with developing countries, put forward the concept of South–South cooperation, and supported the development of other developing countries through technical assistance, economic cooperation (Huang et al., 2018). It also holds a significant position in international trade, finance, technology, and diplomacy (Hu and Lei, 2014). China has gradually realized the importance of English language education in the international communication and economic development, and began to increase the investment (Hu, 2005). In particular, in September 2013, President Xi Jinping proposed the Belt and Road Initiative (Fallon, 2015). The Belt and Road Initiative is China's international economic ambition aimed at promoting economic development across the three sub-regions of Asia, Europe, and Africa. The initiative encompasses infrastructure construction, policy, trade, financial support, and cultural exchanges, and has the potential to reshape the economic landscape of these regions (Zhang et al., 2021).

In the context of globalization, with the rapid development of China's economy and the increasing cross-cultural exchanges (Branstetter and Lardy, 2006), EMI (English as a Medium of Instruction) failed to meet the needs of international students from diverse backgrounds (Li et al., 2020). These factors have prompted studies on multilingualism and foreign language education policies in Chinese higher education (Jin and Cortazzi, 2006). However, under the Belt and Road Initiative, there are also challenges for English education in China. College English teachers are faced with challenges such as a lack of business knowledge, insufficient practical experience, and inadequate learning abilities (Du, 2018). English teachers in China usually find it difficult to incorporate practical and business-oriented content into their courses, primarily because they have limited exposure to that environment. While these teachers have extensive academic backgrounds, they lack practical experience, making it difficult for them to provide language skills applicable to professional contexts and resulting in a reliance on traditional teaching methods (Lei and Medwell, 2022). The Belt and Road Initiative has placed higher demands on English teaching in Chinese universities, including improving listening and speaking abilities, enhancing the infusion of English culture, and emphasizing the value of Business English (Li, 2019). Wang (2020) analyzed the necessity of English teaching resource development, identified problems in past resource development, and proposed recommendations for resource development in terms of development strategies, development process, resource evaluation, and resource development.

Despite China always pay great attention to curriculum quality and the implementation of a series of reform and innovation policies under the Belt and Road Initiative, increasing the quantity and quality of talents has become an urgent goal (Qian, 2019). Therefore, there is a greater need to focus on the cultivation of English talents and integrate research related to the Belt and Road Initiative (Zhang, 2017). In order to comprehensively review past literature and gain a deeper understanding of the English education policy in higher education, some researchers have examined the role of English in China's economical and political contexts from a historical perspective (Adamson, 2002). Poon (2010) has reviewed the language practice in Hong Kong with a historical overview. Furthermore, researchers have

analyzed the function of EMI from a public policy perspective of language policy, including principles of normative legitimacy, feasibility, allocative effectiveness, and fairness (Hu and Alsagoff, 2010). They have also explored the expectations of policy regarding instructional transformation and progress made in achieving this goal through surveys of teachers, administrators, and policy makers (Gao, 2011). Additionally, researchers have also studied Chinese English teachers who adopt new English textbooks and summarized their experiences (Niu-Cooper, 2012). In-depth discussions have taken place regarding English language policies in mainland China and Hong Kong high schools (Li et al., 2023).

In Hong Kong, bilingual educational policies are an important component of the education system (Lau, 2020). High school students in Hong Kong perceive relatively low levels of English learning challenges and tend to adopt English-related learning strategies (Pun and Jin, 2021). As a special administrative region of China, Hong Kong has the potential to cultivate talents with a global perspective, proficient language skills, and cross-cultural competence. However, Hong Kong's engagement with the Belt and Road Initiative is influenced by complex factors such as social, political, and educational issues (Choi and Adamson, 2020), posing challenges to its educational policies. Additionally, there is another special administrative region in China, Macau. English has been recognized as an important language in Macau since the mid-1980s (Botha and Moody, 2020). However, research suggests that EMI in Macau faces challenges, including difficulties in promoting bilingual academic and disciplinary proficiency in English and the mother tongue (Wang and Yu, 2023), as well as challenges faced by Macau students and teachers such as vocabulary demands in English education, listening difficulties, mother tongue influence, and limited interaction opportunities (Reynolds et al., 2022). In light of these challenges, the findings call for critical attention to the role of learner agency and contextual realities in shaping EMI learners' actual strategy use in contexts (Yu et al., 2021). Both Hong Kong and Macau play important roles in China's Belt and Road Initiative (Berlie, 2020). In fact, as part of the Greater Bay Area with Hong Kong and Macau, the alignment between the Belt and Road Initiative and the domestic and global integration is a strategic focus of the Chinese government (Hui et al., 2020). Xu and Sukjairungwattana (2022) conducted a comprehensive study on the opportunities, challenges, and strategies for the sustainable development of higher education in Macau from the perspective of the Guangdong-Hong Kong-Macau Greater Bay Area.

Recently, reasonable solutions have been proposed to promote the development of language education in China (Liu and Biao, 2021). While there is a high demand for curriculum quality, there are few studies that utilize advanced analytical methods to comprehensively evaluate and optimize the implementation of educational policies. Therefore, this paper employs the Latent Dirichlet Allocation (LDA) topic model for research. Prior to this, many scholars have utilized the LDA model for relevant studies in the fields of healthcare (Wu et al., 2014) and patent intelligence (Wang et al., 2014). Currently, there is little research that analyzes the evolution of topics in literature on China's English education policy in higher education during the Belt and Road Initiative period. Analyzing the evolution of theme can help comprehensively grasp the trajectory and internal logic of the development of China's higher education English policies, and provide valuable basis for further improving related policies and educational practices. This paper fills this gap and innovates in research methods.

Different from traditional literature reviews article, this study uses the LDA model combined with Word2Vec word vector technology to systematically and accurately sort out the evolution of topics by mining the texts of literature. This paper aims to fill this gap and further answers the following question:

Q1: What are the topics of English education policy and challenges in China's higher education before and after the Belt and Road Initiative?

Q2: How do the topics in English education policy in China's higher education evolve before and after the Belt and Road Initiative?

Q3: What are the challenges of English education policy in China's higher education before and after the Belt and Road Initiative?

2 Research methodology

This research employed LDA topic model, the high-frequent research topics of English education policy in higher education from 2005 to 2024 was investigated. Then the cosine similarity was calculated with Word2Vec Continuous Bag of Words (CBOW) and Sankey diagram can visualize the evolution of topic. Skip-gram in Word2Vec can summarize challenges in different periods.

2.1 Data collection

"English Education policy in China's Higher Education" published in Web of Science Core Collection during January 2024. The research code is TS=(("China" OR "Chinese") AND ("Higher" OR "University" OR "College" OR "Tertiary") AND ("English") AND ("Education") AND ("Policy" OR "Policies" OR "Strategy" OR "Strategies")) and publish year is during 2005–2024. The study aims to analyze the transformation of the topic and challenges China's higher education faced before and after the Belt and Road Initiative. The Initiative was put forward in 2013. Therefore, we defined 2005–2012 as T1, 2013–2024 as T2. We have retrieved 423 articles published in English in total, T1 contains 36 articles and T2 has 387 articles, respectively.

2.2 Data preprocessing

To improve the reliability of the analysis, the text needs to be cleared. The separation of words and build up of vocabulary modal is achieved through "NLTK" in python (Bird et al., 2009). NLTK is a python library for processing human language data. It provides a series of tools and resources to perform natural language processing (NLP) related tasks. NLTK can complete the following steps: Tokenization, which splits the raw text into individual words. It then removes stop words by deleting some high-frequency but weaker meaning words like "the," "is," "at," etc. Next is stem extraction/lemmatization, which normalizes words to their root form or base form to better perform topic analysis.

2.3 LDA model

2.3.1 LDA model design

Latent Dirichlet Allocation (LDA) is widely employed in digging out the topic and topic model of feature structure in

non-structured text. Through unsupervised machine learning, it can offer the probability distribution of topic in each text. Through abstracting the topic distribution, it can cluster similar topics and analyze the text, then potential topics which will come upon in the future can be predicted (Blei et al., 2003). It can bring a clear text and help to further explore the deep information in the text. Blei et al. (2003) indicated that LDA model is composed of variational three-layer Bayesian model, which shares a logical hierarchy. Each layer is controlled by its own set of parameters. In this model, M represents the number of articles in the training corpus, K represents the number of topics. For each document $m \in \{1, 2, \dots, D\}$, N_m represents the length of document m , that is, the total tokens of each document after tokenization. θ and ϕ stands for the probability distributions of document topics and topic words, respectively. The parameter α is the prior for the topic distribution on documents, also known as a hyperparameter. The parameter β is the prior for the word distribution on topics, also known as an algorithm input. Parameters w and z reflect the probability distributions of feature words in the document collection, as shown in Figure 1.

2.3.2 Determining the optimal number of topics

In the process of building up LDA model, it is usually necessary to set the number of topics based on the size of the text collection. In this paper, the determination of the optimal number of topics is based on the evaluation of topic coherence using the approach proposed by Röder et al. (2015). Topic coherence measures are used in this study. The formula for computing topic coherence is as follows:

$$C_{UMass}(T) = \sum_{m=2}^M \sum_{l=1}^{m-1} \log \frac{D(w_m, w_l) + 1}{D(w_l)}$$

This paper calculates the coherence scores for both the T1 and T2 periods and determines the optimal number of topics based on the scoring results. The optimal number of topics for the T1 is 6, while for the T2, it is 8 (as shown in Figures 2, 3).

2.3.3 LDA topic modeling

This study utilizes the GENSIM in python to train an LDA model on preprocessed texts. Based on the results of coherence calculation, the number of topics, K , is set as 6 for the T1 and 8 for the T2. The model is configured with parameters passes = 30, random-state = None, alpha = "symmetric," eta = None, with 30 iterations. For each topic, the top 10 words with the highest probabilities are extracted and sorted in descending order based on their frequencies.

2.4 Word2Vec

Word2Vec was developed by Mikolov et al. (2013). It is a technique used to represent words as continuous vectors. It is a distributed representation method based on neural networks. The goal of Word2Vec is to learn approximate representations of words with semantic similarity in a vector space. Word2Vec is on the basis of the assumption that words with similar contexts in natural language often have similar meanings. Based on this assumption, the Word2Vec model learns distributed representations of words by analyzing large scale corpus. Mikolov et al. (2013) pointed out that Word2Vec has two

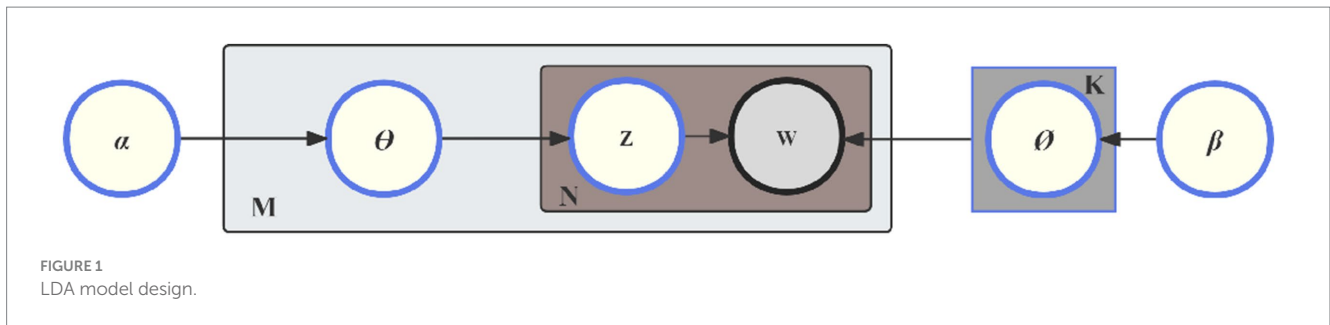


FIGURE 1 LDA model design.

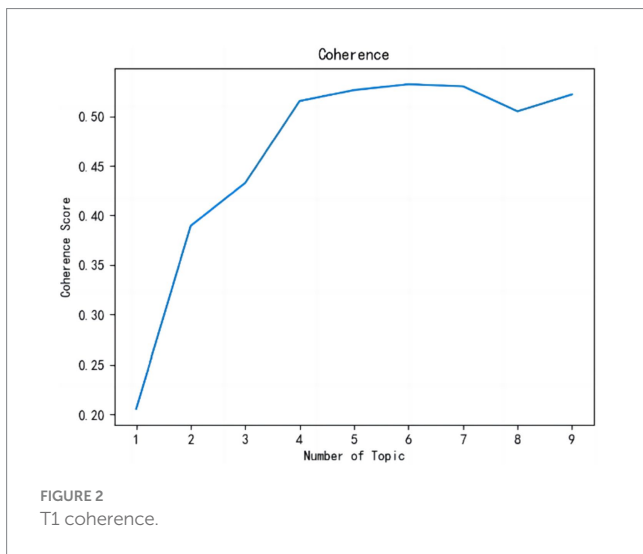


FIGURE 2 T1 coherence.

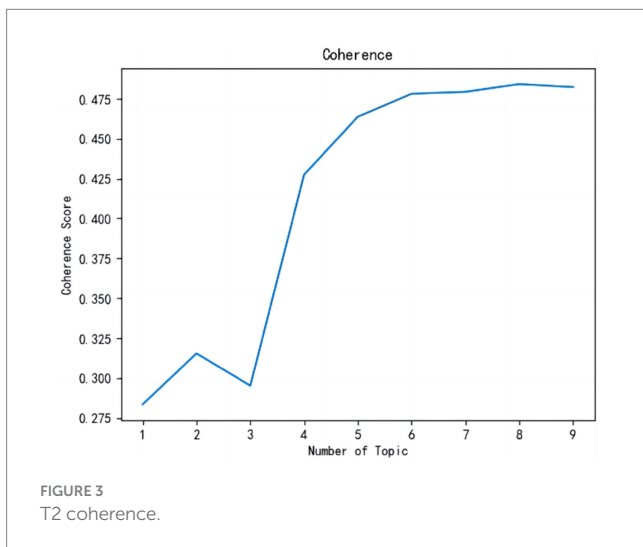


FIGURE 3 T2 coherence.

main model architectures: Continuous Bag of Words (CBOW) and Skip-gram. The essence of both models is to train a neural network to predict the context or target word of a given word.

2.4.1 Computing topic vectors in CBOW

In the CBOW model, the input to the model is the context words, and the output is the target word. The goal of the model is to predict the target word based on the context words. (The principle is illustrated in Figure 4.)

This paper utilized the Word2Vec model to train a 100-dimensional CBOW word vector model based on the given text data. The model was trained with a window size of 5, a word frequency threshold of 1, using 4 threads, and underwent 100 iterations. Finally, the obtained word vectors are used to calculate the cosine similarity for subsequent analysis.

2.4.2 Modeling with skip-gram

In the skip-gram model, the input to the model is the target word, and the output is the context words of the target word. The objective of the model is to predict the context words based on the target word. The principle is illustrated in Figure 5.

2.5 Cosine similarity calculation

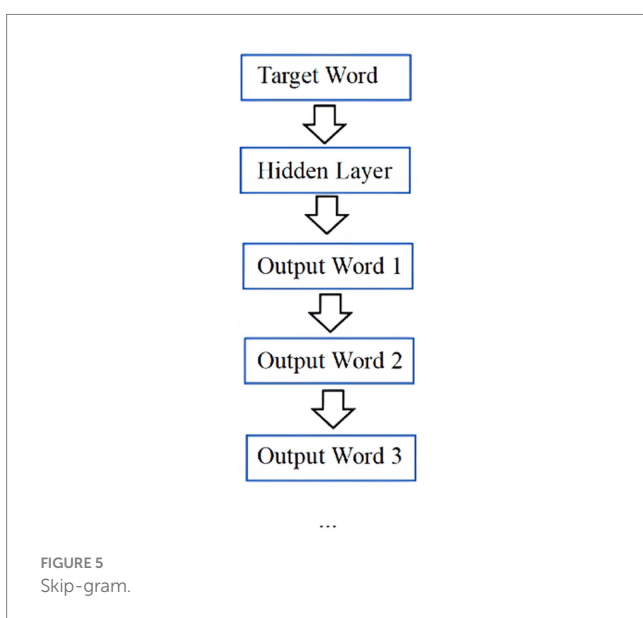
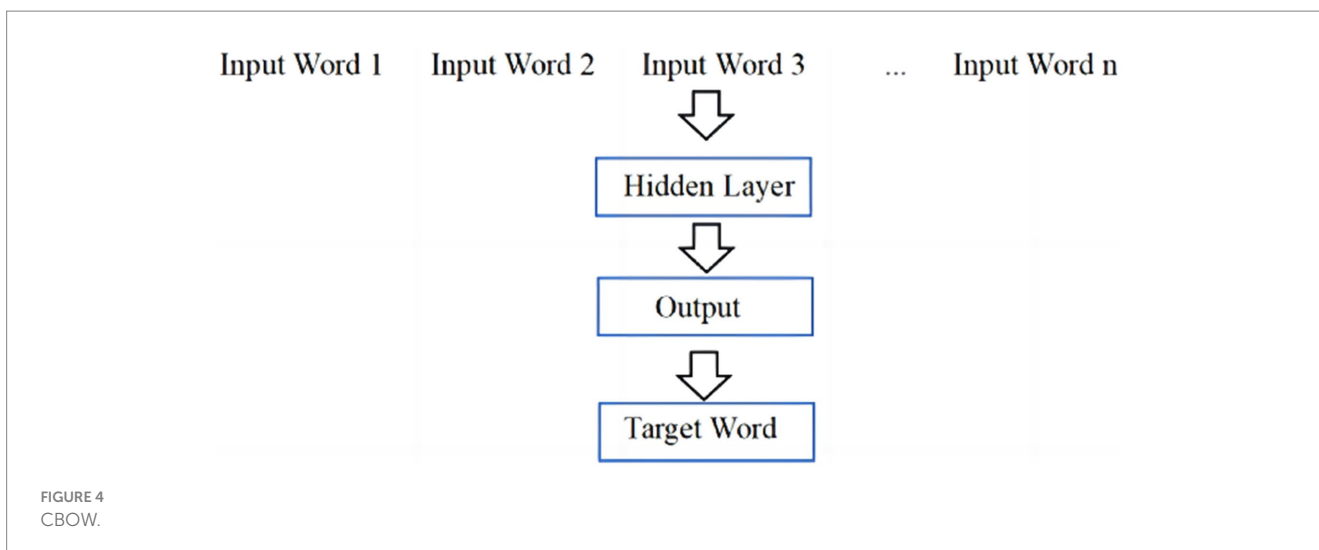
In this paper, the cosine similarity between the topic vectors of T1 and T2 is computed. Cosine similarity is a measure of similarity between vectors, and it ranges from -1 to 1. A value closer to 1 indicates a higher similarity between vectors, while a value closer to -1 indicates a lower similarity. The calculated similarity data is stored in a data-frame (Table 1) for further visualization, the numbers in the first column and the first row represent the topics in the T1 period and T2 period, respectively. This data will be used to generate a Sankey diagram.

Cosine similarity is a measure of the similarity between two vectors, ranging from -1 to 1. In this analysis, the topics from periods T1 and T2 are both represented as vectors, and their cosine similarities are calculated. The closer the cosine similarity is to 1, the more similar the two topic vectors are; the closer to -1, the less similar they are. In Table 1, the first column and first row correspond to the topic numbers of periods T1 and T2, respectively. The values in the table are the cosine similarities between the topic vectors of periods T1 and T2. For example, the similarity between topic 0 of T1 and topic 7 of T2 is 0.201861. By calculating the cosine similarities between the topic vectors of periods T1 and T2, it can reflect the consistency and changes between the topics of the two periods. A higher similarity indicates the topics' contents are more similar and the changes are smaller between the two periods; a lower similarity means the topics have undergone greater changes. These similarity data provide the basis for the subsequent Sankey diagram visualization, which can intuitively show the evolution of topics over time.

3 Results and discussion

3.1 Keywords

After LDA modeling for the T1 and T2, keywords cloud visualizations were generated based on the frequency of each keyword



in T1 and T2. The keywords cloud visualizations are shown in the Figures 6, 7.

According to the word cloud in Figure 6 during the T1 period, there are six topics.

Topic 0: “writing,” “participants,” “academic,” “development,” “proficiency,” “region,” “vocabulary,” “practices,” “social.”

Topic 1: “test,” “Cantonese,” “support,” “creative,” “role,” “major,” “CECR (Common European Framework of Reference for Languages),” “data,” “mainland,” “factors.”

Topic 2: “reform,” “market,” “ICT (Information and Communications Technology),” “paper,” “practice,” “experience,” “provision,” “attitudes,” “examination,” “communication.”

Topic 3: “online,” “pedagogy,” “intercultural,” “environment,” “publication,” “level,” “socialization,” “future,” “model,” “survey.”

Topic 4: “ICT,” “assessment,” “article,” “compliments,” “bilingual,” “ability,” “autonomy,” “learner,” “current,” “tests.”

Topic 5: “international,” “classroom,” “national,” “interviews,” “ESL (English as a Second Language),” “journal,” “courses,” “performance,” “HSS (Humanities and Social Sciences),” “practice.”

In T1 period, during this stage, the policy began to support the integration of Information and Communication Technology (ICT) into teaching and improve teaching methods and practice to enhance students’ learning outcomes. Additionally, scholars during this period had already recognized the importance of intercultural communication competence and international education in cultivating students’ global perspectives and intercultural communication competence (Hu, 2005). However, overall, the English education policy in China during this period placed a greater emphasis on developing students’ writing skills and improving academic proficiency. Therefore, the policies during this period mainly focused on improving the English examination system and related aspects.

In the topics from 0 to 7 after the Belt and Road Initiative (T2), Topic 0: “classroom,” “social,” “perceptions,” “multilingual,” “article,” “practice,” “schools,” “intercultural,” “perceived,” “paper” (Figure 7).

Topic 1: “international,” “bilingual,” “resources,” “revealed,” “business,” “content,” “competence,” “management,” “Japanese,” “multilingualism.”

Topic 2: “contexts,” “experiences,” “based,” “current,” “focus,” “influence,” “reports,” “international,” “identities,” “subject.”

Topic 3: “national,” “qualitative,” “challenges,” “programmers,” “data,” “medical,” “lack,” “online,” “studying,” “issues.”

Topic 4: “self-efficacy,” “professional,” “EMI,” “listening,” “participants,” “satisfaction,” “writing,” “improve,” “instructors,” “potential.”

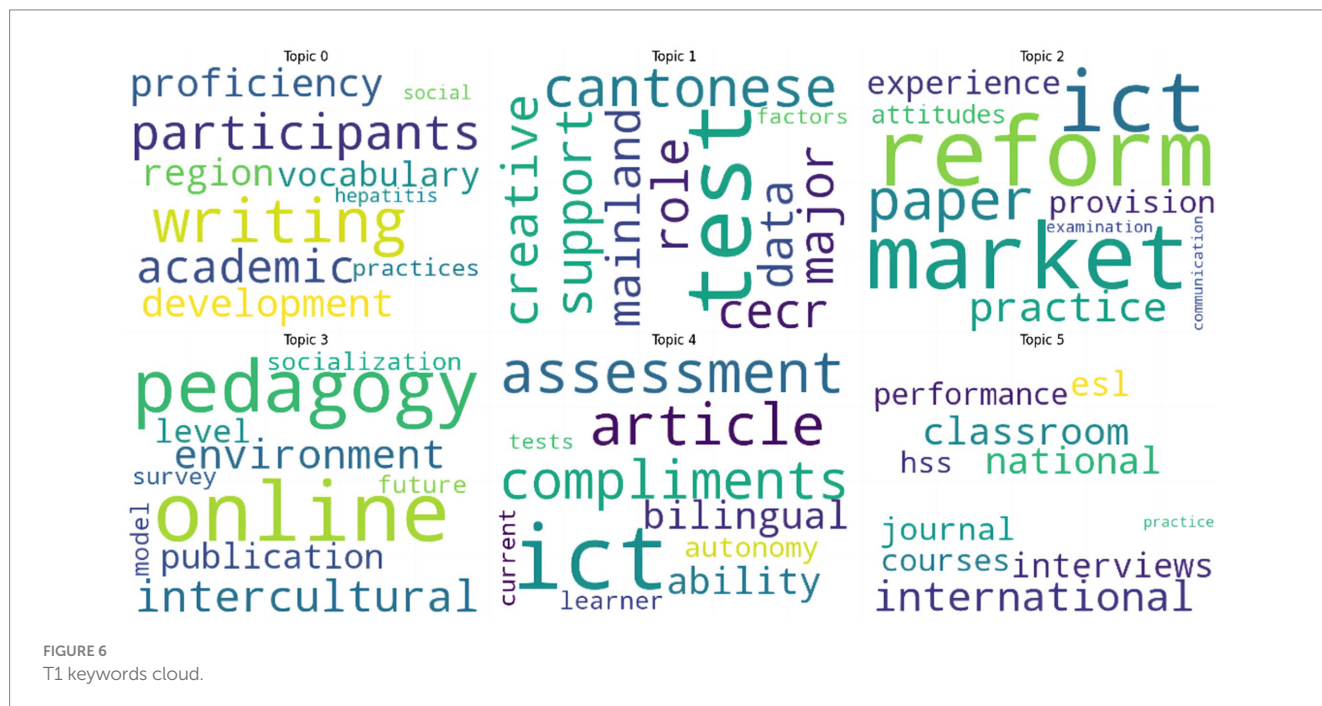
Topic 5: “identity,” “countries,” “development,” “quality,” “engagement,” “skills,” “provide,” “differences,” “semi-structured,” “discussed.”

Topic 6: “EFL (English as a Foreign Language),” “LOTE (Language Other Than English),” “EMI (English as a Medium of Instruction),” “academic,” “questionnaire,” “global,” “attitudes,” “linguistic,” “agency,” “motivation.”

Topic 7: “EMI,” “pedagogical,” “knowledge,” “translanguaging,” “feedback,” “health,” “effective,” “attention,” “performance,” “examines.”

TABLE 1 Cosine similarity calculation.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|
| 0 | -0.129648 | 0.189121 | -0.09066 | -0.226286 | 0.027621 | 0.048874 | 0.13499 | 0.201861 |
| 1 | 0.072763 | 0.115919 | 0.171581 | 0.03712 | -0.025868 | -0.0445 | 0.251426 | -0.068916 |
| 2 | -0.067174 | 0.001314 | 0.159769 | -0.036222 | 0.139034 | 0.061245 | -0.013023 | 0.241857 |
| 3 | -0.037507 | -0.12843 | 0.068671 | 0.001158 | -0.030733 | -0.108409 | 0.187197 | 0.055338 |
| 4 | 0.032424 | -0.208882 | 0.498143 | -0.067629 | -0.144574 | -0.130269 | 0.196144 | 0.098108 |
| 5 | -0.044767 | 0.049534 | 0.094771 | 0.270535 | 0.142885 | 0.207163 | -0.027814 | -0.000686 |



During T2 period, scholars focused more on practice, intercultural communication, international education cooperation, bilingual education, and challenges in online learning. The policies during this period also paid more attention to students themselves, such as their professional development, engagement, attitudes, background characteristics, identity, and even aspects related to student health and attention, which is consistent with Li (2019).

3.2 Evolution of challenges

The purpose of this article is to analyze the challenges in China's higher education English education policy during T1 and T2 periods. Therefore, in the Skip-gram modeling, the target word chosen is "challenges." The results of the execution display the top five words most closely related to "challenges" in the T1 and T2 periods, as shown in Tables 2, 3.

During the T1 period before the Belt and Road Initiative, the challenges in China's English education policy mainly focused on improving students' writing abilities, English proficiency, and creativity, as well as emphasizing practice. In the post Belt and

Road Initiative period (T2), China's higher education English education policy shifted toward investigating and addressing challenges in areas such as research and interviews on educational challenges, linguistics and media influences, educational institutions and programs, online courses and academic research, attitudes and self-efficacy, multilingualism and globalization, teaching and current educational issues, as well as curriculum design and writing. The above findings confirm the viewpoint of Hu (2005).

3.3 Evolution of topics

This study presents the evolution of topics in the T1 and T2 using a cosine similarity calculation. The Sankey diagram in Figure 8, illustrates the transition from the T1 period on the left column to the T2 period on the right column.

From the Topic Evolution Map in Figure 8, it can be observed that before and after the Belt and Road Initiative, there have been numerous and complex evolutions in the topics of China's English education policy. Based on the cosine similarity calculations, this

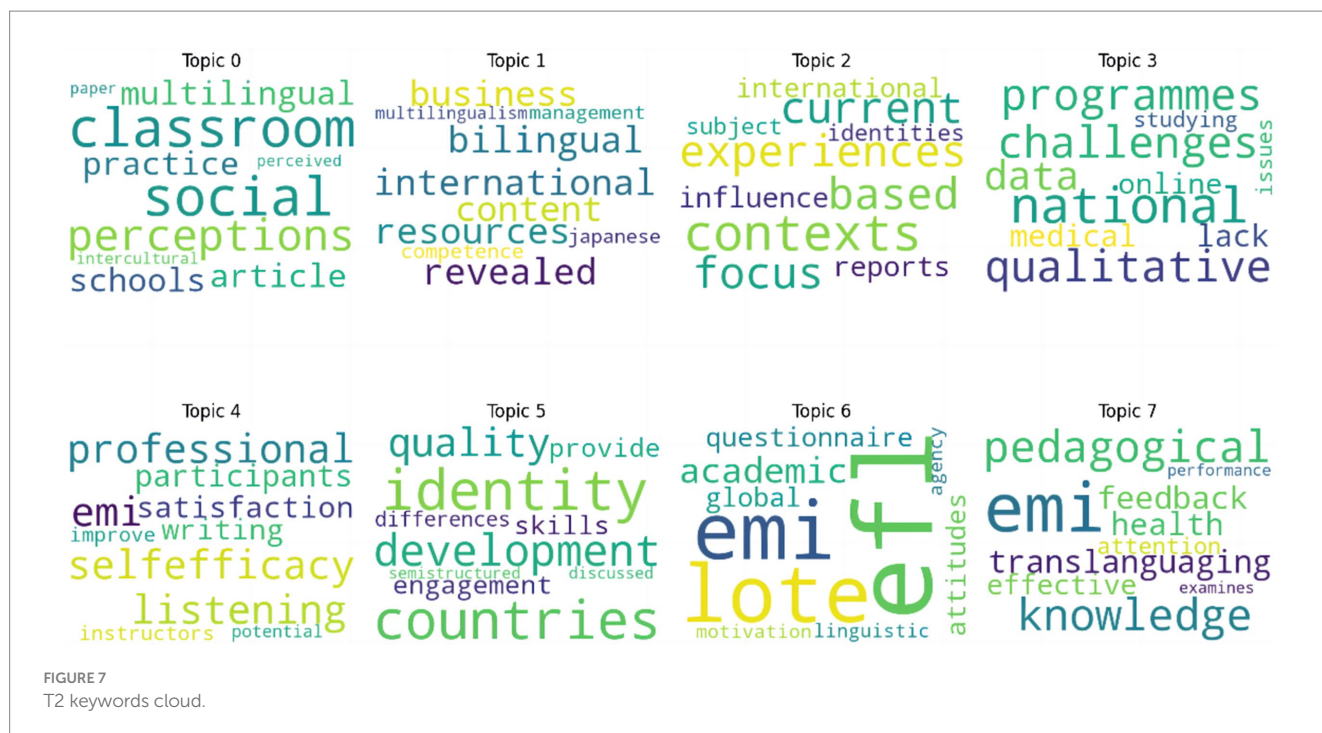


FIGURE 7
T2 keywords cloud.

TABLE 2 T1 keywords frequency.

| Word | Frequency |
|-------------|--------------------|
| Writing | 0.7425274848937988 |
| Proficiency | 0.7348564863204956 |
| Aims | 0.72028648853302 |
| Creative | 0.7192969918251038 |
| Practice | 0.7175012826919556 |

TABLE 3 T2 keywords frequency.

| Word | Frequency |
|--------------|--------------------|
| Key | 0.9995166063308716 |
| Support | 0.999503493309021 |
| Countries | 0.9995002150535583 |
| Disciplinary | 0.999491810798645 |
| Context | 0.9994884133338928 |

paper selects seven pathways with values greater than 0.3 for in-depth analysis. These pathways include the transition from Topic 0 in the T1 period to Topic 1, 2, 6, and 7 in T2 period, as well as the transition from Topic 2 in the T1 period to Topic 1, 6, and 7 in the T2 period. Based on these pathways, this paper integrates two main evolving themes.

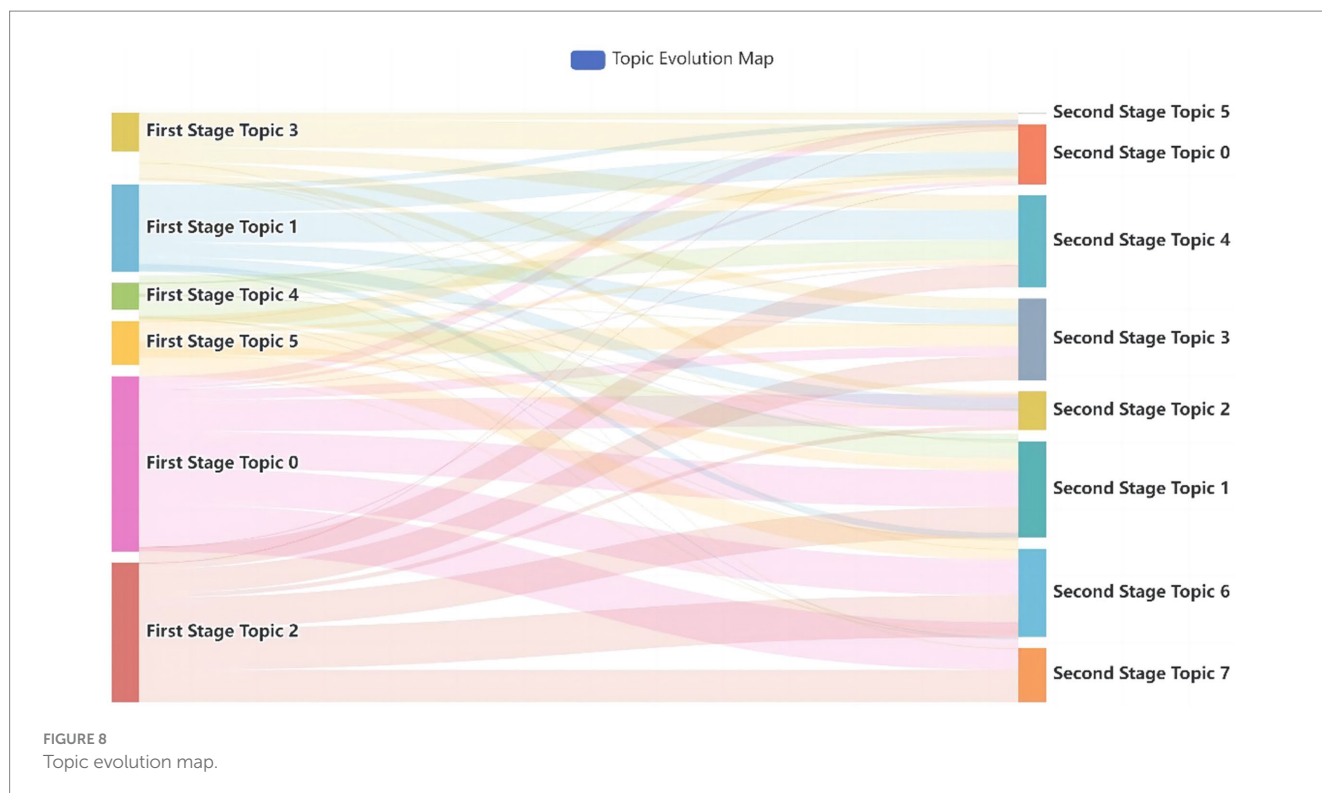
3.3.1 Shift in focus from examinations to cultivating students’ intercultural communication skills

In T1 period before the Belt and Road Initiative, China’s English education policy primarily focused on education related to writing, academic skills, and vocabulary. The vocabulary included terms related to classroom teaching and learning, such as “participants” and “vocabulary,” indicating that before the Belt and Road Initiative, the main focus of China’s English education policy was on cultivating students’ English proficiency through examinations (Sun et al., 2017). However, the Belt and Road Initiative requires extensive cooperation between China and countries along the route, leading to an increase in cross-cultural exchanges (Branstetter and Lardy, 2006). Therefore, in T2 period, there are more vocabulary terms related to internationalization, intercultural communication,

and national aspects. This reflects the influence of the Belt and Road Initiative on the promotion of strategies to cultivate students’ intercultural communication skills, highlighting the increasing emphasis in the education field on the importance of internationalized education and cross-cultural communication. For example, Hong Kong, which originally prefers EMI (Pun and Jin, 2021), and Macau are expected to place greater emphasis on nurturing students’ multilingual abilities and cross-cultural communication skills under the complex influence of the Belt and Road Initiative (Choi and Adamson, 2020) to meet the demands of multicultural exchanges in a globalized context (Zeng and Wang, 2023).

3.3.2 Evolution of teaching strategies

Before the Belt and Road Initiative, teaching strategies primarily focused on exam-oriented approaches. During this period, the education system placed a general emphasis on educational reforms and improving students’ exam scores in order to stand out in the competitive job market (Li et al., 2023). However, after the Belt and Road Initiative, scholars began to realize that traditional teaching methods and assessment approaches may not meet the needs of students in the era of globalization (Feng, 2023). Therefore, Yu et al.



(2022, 2023) conducted a research on blended learning and found that it yielded significantly better learning outcomes than traditional learning methods. They also found that students exhibited significantly stronger learning motivation in blended learning compared to traditional English learning. This transformation reflects the response to new demands (Qian, 2019) and challenges (Du, 2018) in China's English education after the Belt and Road Initiative.

3.3.3 English education and multilingual education

In the context of the Belt and Road Initiative, Zhang (2017) and Qian (2019) argued that it is necessary to place greater emphasis on cultivating English talents. However, in T2 period following the initiative, the enthusiasm for English education in Chinese higher education is cooling down. Nevertheless, the demand for higher English proficiency was increasing (Fan, 2023). Additionally, during this period, more terms related to multilingual education emerged, such as English as a Foreign Language (EFL) and Languages Other Than English (LOTE). This evolutionary path aligned with the situation identified by Li et al. (2020), who stated that EMI failed to meet the needs of international students from diverse backgrounds. This indicated that under the influence of the Belt and Road Initiative, education authority was paying more attention to language education and the development of multilingual abilities.

4 Conclusion

China has proposed the Belt and Road Initiative to strengthen regional connectivity. To have a better understanding of the impact

of the Initiative on China's English education policy, this study employs LDA and Word2Vec to reveal the high-frequency research topics in China's English education policy from 2005 to 2024. Through calculating the cosine similarity of the CBOW and visualizing the topic evolution using Sankey diagrams, and further summarizing the challenges faced in different periods using the skip-gram in Word2Vec, the study finds that the Initiative had a profound impact on China's English education policy. The Initiative has led to a shift in policy priorities, which is consistent with the study of Yu et al. (2021). From focusing on improving students' writing ability, English proficiency, and creativity, to cultivating students' cross-cultural communication skills so as to meet the cooperation needs of countries along the Belt and Road. In order to enhance students' learning outcomes and motivation, the teaching strategies have also undergone significant changes, shifting from an exam-oriented approach to an emphasis on teaching methods and feedback.

Meanwhile, the challenges faced by English education policy have also evolved from emphasizing students' basic skills and practical skills to conducting in-depth research and solving real-life problems in the education. These findings provide policymakers with a more comprehensive and in-depth understanding about the English education policy, enabling them to better address the educational needs and challenges in the context of globalization.

However, this study is not without limitations. This study only analyzes journals from Web of Science, and the language is limited within English, in the future, the research can take journals written in other languages into consideration to make a more comprehensive analysis. Moreover, Future research can verify the

findings of this study through other research methods like surveys, interviews, and case studies, and further explore the impact of Belt and Road Initiative. This study will provide important insights for the reform of China's English education policy in the future.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

Author contributions

FL: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. HH: Conceptualization, Data curation, Methodology, Writing – original draft. ZL: Writing – review & editing, Visualization.

References

- Adamson, B. (2002). Barbarian as a foreign language: English in China's schools. *World Englishes* 21, 231–243. doi: 10.1111/1467-971X.00244
- Berlie, J. A. (2020). Hong Kong special administrative region, China, and globalization. *Asian Educ Dev Stud* 9, 268–276. doi: 10.1108/AEDS-10-2017-0105
- Bird, S., Klein, E., and Loper, E. (2009). *Natural language processing with Python: Analyzing text with the natural language toolkit*. Sebastopol, USA: O'Reilly Media, Inc.
- Blei, D. M., Ng, A. Y., and Jordan, M. I. (2003). Latent Dirichlet allocation. *J. Mach. Learn. Res.* 3, 993–1022.
- Botha, W., and Moody, A. (2020). "English in Macau" in *The handbook of Asian Englishes*. eds. K. Bolton, W. Botha and A. Kirkpatrick. 1st ed (USA: John Wiley & Sons), 529–546.
- Branstetter, L., and Lardy, N. (2006). *China's embrace of globalization*. Cambridge, MA: National Bureau of Economic Research, w12373.
- Cheng, A., and Wang, Q. (2012). "English language teaching in higher education in China: a historical and social overview" in *Perspectives on teaching and learning English literacy in China*. eds. J. Ruan and C. B. Leung, vol. 3 (Netherlands: Springer), 19–33.
- Choi, T.-H., and Adamson, B. (2020). "China's belt and road initiative: opportunities and linguistic challenges for Hong Kong" in *Multilingualism and politics*. ed. K. Strani (Singapore: Palgrave MacMillan), 261–284.
- Du, R. (2018). Research on challenges faced with college English teachers and promotion paths under the background of belt and road. In: *Proceedings of the 2017 5th International Education, Economics, Social Science, Arts, Sports and Management Engineering Conference (IEESASM 2017)*. Qingdao, China.
- Fallon, T. (2015). The new silk road: xi Jinping's grand strategy for Eurasia. *Am Foreign Policy Interests* 37, 140–147. doi: 10.1080/10803920.2015.1056682
- Fan, H. (2023). Winter is coming? University teachers' and students' views on the value of learning English in China. *Rev. Educ.* 11:e3410. doi: 10.1002/rev3.3410
- Feng, Y. (2023). Analysis and countermeasures of cultivating independent learning ability in colleges teaching English based on OBE theory. *Appl Maths Nonlinear Sci* 8, 571–580. doi: 10.2478/amns.2021.2.00298
- Gao, L. (2011). Eclecticism or principled eclecticism. *Creat. Educ.* 2, 363–369. doi: 10.4236/ce.2011.24051
- Guo, Y. (2013). Teaching english for economic competitiveness: emerging issues and challenges in english education in China. *Comp. Int. Educ.* 41. doi: 10.5206/cie-eci.v41i2.9202
- Hu, G. (2005). English language education in China: policies, Progress, and problems. *Lang. Policy* 4, 5–24. doi: 10.1007/s10993-004-6561-7
- Hu, G., and Alsagoff, L. (2010). A public policy perspective on English medium instruction in China. *J. Multiling. Multicult. Dev.* 31, 365–382. doi: 10.1080/01434632.2010.489950
- Hu, G., and Lei, J. (2014). English-medium instruction in Chinese higher education: a case study. *High. Educ.* 67, 551–567. doi: 10.1007/s10734-013-9661-5
- Huang, M., Xu, X., and Mao, X. (2018). *South-south cooperation and Chinese foreign aid*. Palgrave Macmillan Singapore: Springer.
- Hui, E. C. M., Li, X., Chen, T., and Lang, W. (2020). Deciphering the spatial structure of China's megacity region: a new bay area—the Guangdong-Hong Kong-Macao Greater Bay Area in the making. *Cities* 105:102168. doi: 10.1016/j.cities.2018.10.011
- Jin, L., and Cortazzi, M. (2006). Changing practices in Chinese cultures of learning. *Lang. Cult. Curric.* 19, 5–20. doi: 10.1080/07908310608668751
- Lau, C. (2020). English language education in Hong Kong: a review of policy and practice. *Curr Iss Lang Plan* 21, 457–474. doi: 10.1080/14664208.2020.1741239
- Lei, M., and Medwell, J. (2022). The changing role of Chinese english-as-foreign-language teachers in the context of curriculum reform: Teachers' understanding of their new role. *Front. Psychol.* 13:904071. doi: 10.3389/fpsyg.2022.904071
- Li, H., Wang, H., Cousineau, C., and Boswell, M. (2023). What can students gain from China's higher education? *Asian Econ Policy Rev* 18, 287–304. doi: 10.1111/aepr.12426
- Li, J. (2019). Research on innovative Design of College English Teaching under the of the belt and road initiative. In *2019 international conference on advanced education, service and management* (Vol. 3, pp. 245–249). The Academy of Engineering and Education.
- Li, J., Xie, P., Ai, B., and Li, L. (2020). Multilingual communication experiences of international students during the COVID-19 pandemic. *Multilingual* 39, 529–539. doi: 10.1515/multi-2020-0116
- Liu, B., and Biao, J. (2021). Strategic evolution of language education policy in the information age. *J. Phys. Conf. Ser.* 1744:032043. doi: 10.1088/1742-6596/1744/3/032043
- Mavroidis, P. C., and Sapir, A. (2019). *China and the world trade organisation: Towards a better fit*. Bruxelles/Brussel: Bruegel Working Papers.
- Mikolov, T., Sutskever, I., Chen, K., Corrado, G. S., and Dean, J. (2013). Distributed representations of words and phrases and their compositionality. In: *Advances in Neural Information Processing Systems*, 26.
- Niu-Cooper, R. (2012). Unexpected realities: lessons from China's new English textbook implementation. *Int. J. Educ. Policy Leadersh.* 7, 1–17.
- Poon, A. Y. K. (2010). Language use, and language policy and planning in Hong Kong. *Curr Iss Lang Plan* 11, 1–66. doi: 10.1080/14664201003682327
- Pun, J., and Jin, X. (2021). Student challenges and learning strategies at Hong Kong EMI universities. *PLoS One* 16:e0251564. doi: 10.1371/journal.pone.0251564
- Qian, Y. (2019). Analysis on the cultivation path of the compound English talents in the context of the belt and road strategy. In: *Proceedings of the 3rd International Conference on Culture, Education and Economic Development of Modern Society (ICCESE 2019)*. Moscow, Russia.
- Reynolds, B. L., Xie, X., and Pham, Q. H. P. (2022). Incidental vocabulary acquisition from listening to English teacher education lectures: A case study from Macau higher education. *Front. Psychol.* 13:993445. doi: 10.3389/fpsyg.2022.993445
- Röder, M., Both, A., and Hinneburg, A. (2015). Exploring the space of topic coherence measures. In In: *Proceedings of the eighth ACM international conference on Web search and data mining* (pp. 399–408).
- Sun, J. J.-M., Hu, P., and Ng, S. H. (2017). Impact of English on education reforms in China: with reference to the learn-English movement, the internationalisation of

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- universities and the English language requirement in college entrance examinations. *J. Multiling. Multicult. Dev.* 38, 192–205. doi: 10.1080/01434632.2015.1134551
- Wang, B., Liu, S., Ding, K., Liu, Z., and Xu, J. (2014). Identifying technological topics and institution-topic distribution probability for patent competitive intelligence analysis: a case study in LTE technology. *Scientometrics* 101, 685–704. doi: 10.1007/s11192-014-1342-3
- Wang, J. (2020). Research on the development and construction of English teaching resources system against the background of “the belt and road initiative.” In: *2020 5th international conference on mechanical, control and computer engineering (ICMCCCE)*, 1953–1958.
- Wang, Y., and Yu, S. (2023). Learning through EMI (English-medium instruction) in a Macau university: students’ perspectives and content and language outcomes. *Asia Pac J Educ*, 1–17. doi: 10.1080/02188791.2023.2270725
- Wu, Q., Zhang, C., Hong, Q., and Chen, L. (2014). Topic evolution based on LDA and HMM and its application in stem cell research. *J. Inf. Sci.* 40, 611–620. doi: 10.1177/0165551514540565
- Xu, W., and Sukjairungwattana, P. (2022). The study of Macau’s higher education 1999–2019. *Front Educ* 7:898238. doi: 10.3389/feduc.2022.898238
- Yu, S., Wang, Y., Jiang, L., and Wang, B. (2021). Coping with EMI (English as a medium of instruction): mainland China students’ strategies at a university in Macau. *Innov. Educ. Teach. Int.* 58, 462–472. doi: 10.1080/14703297.2020.1784248
- Yu, Z., Xu, W., and Sukjairungwattana, P. (2022). Meta-analyses of differences in blended and traditional learning outcomes and students’ attitudes. *Front. Psychol.* 13:926947. doi: 10.3389/fpsyg.2022.926947
- Yu, Z., Xu, W., and Sukjairungwattana, P. (2023). Motivation, learning strategies, and outcomes in Mobile English language learning. *Asia Pac. Educ. Res.* 32, 545–560. doi: 10.1007/s40299-022-00675-0
- Zeng, J., and Wang, X. (2023). The China’s foreign language education policies along with the belt and road Initiative’s implementation: retrospect and prospect. *Modern J Stud Engl Lang Teach Liter* 5:477. doi: 10.56498/512023477
- Zhang, D., Mohsin, M., Rasheed, A. K., Chang, Y., and Taghizadeh-Hesary, F. (2021). Public spending and green economic growth in BRI region: mediating role of green finance. *Energy Policy* 153:112256. doi: 10.1016/j.enpol.2021.112256
- Zhang, L. (2017). Employment oriented English talents training under the background of the belt and road Initiatives. In: *Proceedings of the 2017 3rd International Conference on Social Science and Higher Education*. Sanya, China.