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## Using Baidu Index Data to Explore the Spatiotemporal Characteristics of Public Concern towards Online English Learning

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### Article Info

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### Abstract

This study examines the spatiotemporal dynamics of public interest in online English learning, particularly for young learners in China from June 2020 to June 2024 using Baidu Index data. Relevant keywords were selected and demographic filters were applied to focus on users aged 19+. The analysis revealed a surge in interest during the COVID-19 pandemic's early stages, followed by a decline. Eastern regions showed higher concern, and parents and educators were key contributors to search volumes. External factors, including policy changes and the pandemic, significantly influenced public sentiment. The findings underscore the dynamic nature of public concern and the need for educators and policymakers to adapt to these trends in shaping the future of online English education.

**Keywords:** *Online english learning, Baidu index, Spatiotemporal characteristics, Public concern, Parental engagement*

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### 1. Introduction

In the digital age, the landscape of education is rapidly evolving, with online English learning becoming increasingly popular particularly for young learners. However, understanding the public's perception and concern regarding this trend is crucial for its sustainable development. In China, online English learning platforms have experienced exponential growth in recent years, offering convenience and flexibility to young learners. Despite their prevalence, there is a need to examine how public concern is distributed both temporally and spatially. Previous studies (Chen and Heng, 2024; Fenyvesi, 2018; Unsworth *et al.*, 2014) have explored the efficacy of online learning for young English learners (hereinafter referred to as "YEL"), but there is a paucity of research on the public's spatiotemporal concerns regarding online English learning for young learners, particularly from the perspective of big data. This study aims to investigate the spatiotemporal characteristics of public concern towards online English learning for young learners using Baidu Index data. The findings of this study will provide valuable insights for educators to tailor their offerings and for policymakers to create informed regulations, ultimately shaping the future of online English education (family English education included). The study focuses on data from Baidu Index within a specific time frame and demographic, which may limit the generalizability of the results. However, the research aims to address questions such as: How does public concern for online English

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learning fluctuate over time, particularly regarding parental involvement? And what experiences and preferences are expressed in relation to the regional differences in this concern?

## 2. Materials and Methods

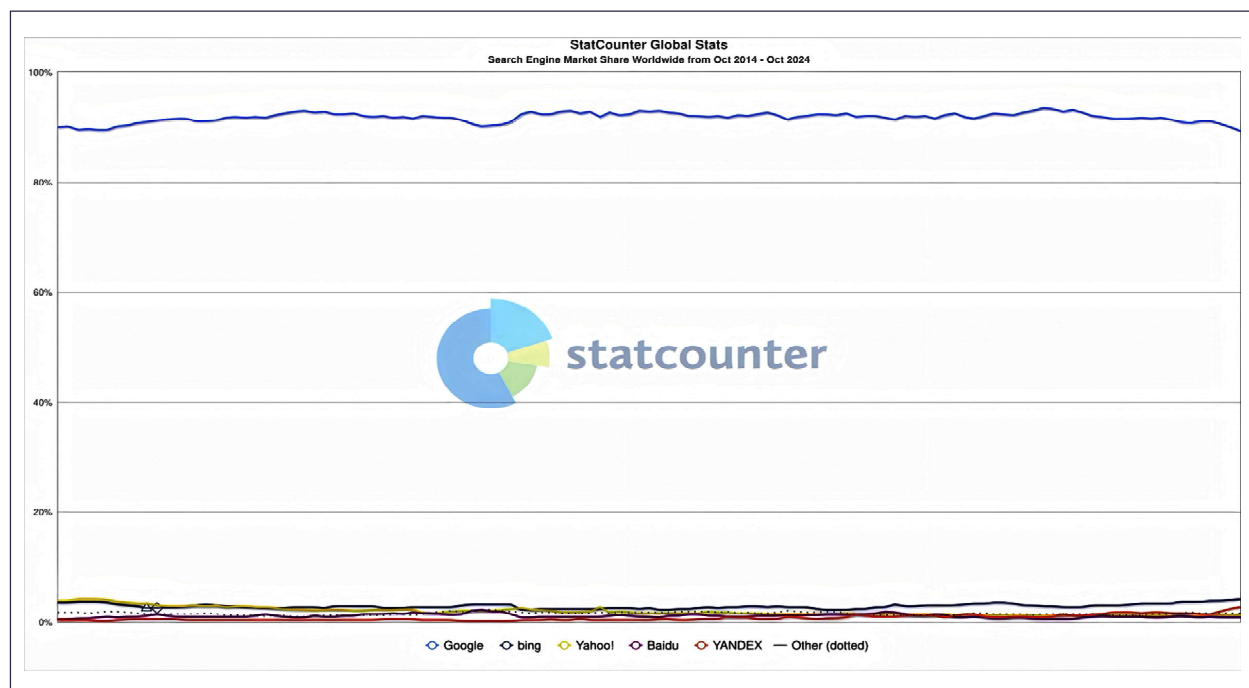
### 2.1. Materials

Search engines and auto-recommendations are vital for information access, with derived online indices crucial for computational sociology research, particularly search engine indices for predicting social event dissemination and impact (Chenggang *et al.*, 2021). According to Statcounter Global Stats, Google has maintained a dominant position in the global search engine market, with its market share consistently above 90% throughout the observed period (from October 2014 to October 2024) (Figure 1). In addition, the use of Google Trends in research has surged, shifting the focus from merely describing trends to predicting changes, while also expanding the joint analysis with other big data sources (Seung-Pyo *et al.*, 2018). However, as the most widely used search engine in China (Figure 2), Baidu provides a robust dataset that reflects the interests and concerns of the Chinese population. Regarding its big-data platform, Baidu Index is a significant resource for understanding search trends and public interest in China, much like Google Trends is for the global audience.

Baidu Index, launched in 2006, is based on over 6 billion daily search requests, making it the most authoritative open Internet big data indicator in China. It includes two Internet access interfaces (PC and mobile devices) and three content sections, namely, “trend research”, “demand map”, and “user portrait”, offering comprehensive insights into user behavior and market trends.

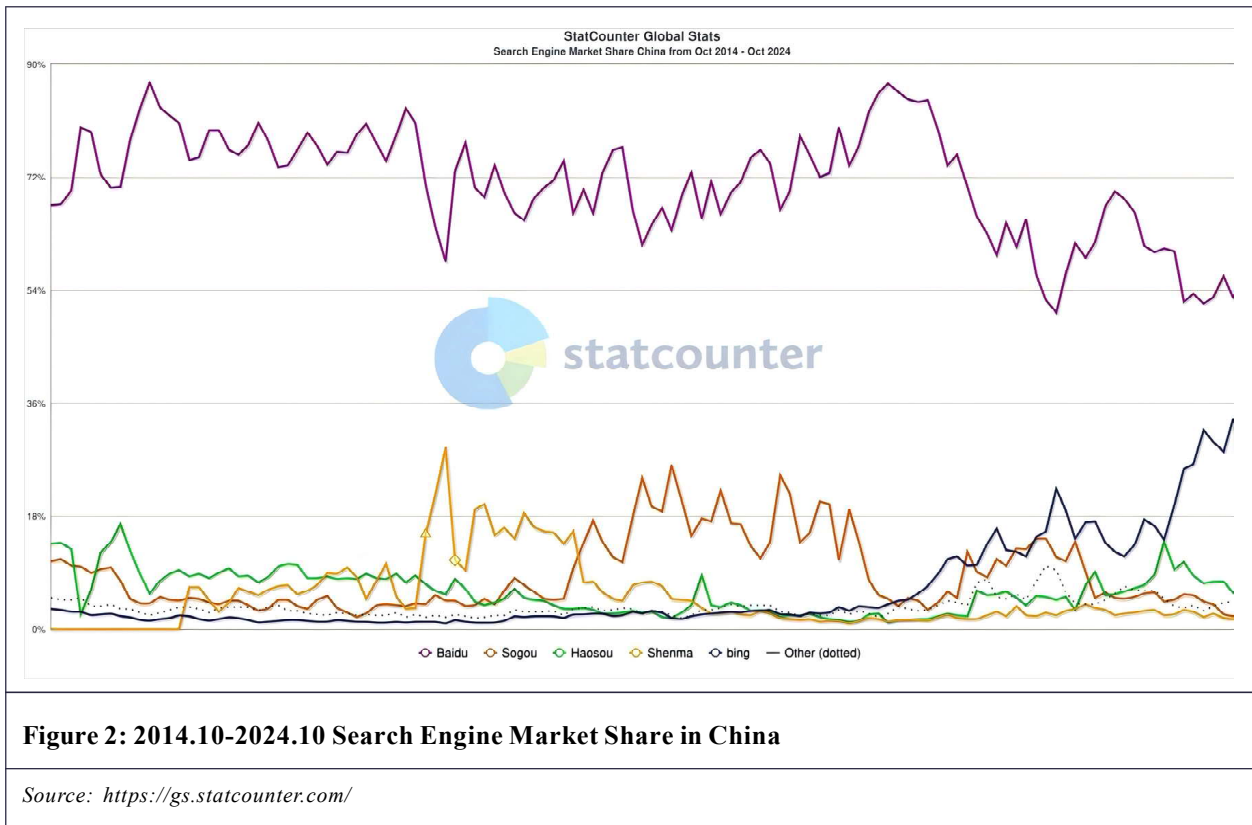
In comparison to other search engines like Yahoo or Bing, which have a more global focus, Baidu Index offers a more nuanced understanding of search behavior specific to Chinese-speaking users. This makes it an essential tool for those looking to understand the dynamics of online behavior and public discourse in China, despite its relatively lower global market share as shown in Figure 1.

The relevance of Baidu Index to studies focusing on online English learning, particularly for YELs is substantial. It can be used to track the level of attention towards this topic, reflecting the search behavior and interest of internet users on a population level. By monitoring the search trends of keywords related to online English learning, researchers can gain insights into the evolving needs and preferences of young learners and their families, as well as the public’s overall interest in this educational domain.



**Figure 1: 2014.10-2024.10 Search Engine Market Share Worldwide**

Source: <https://gs.statcounter.com/>



## 2.2. Methods

### 2.2.1. Data Collection Process

#### 2.2.1.1. Time Frame

Data of this paper was collected from Baidu Index over a period of five years, from June 2020 to June 2024, to capture a comprehensive view of the trends in public interest.

#### 2.2.1.2. Keywords Selection

Keywords such as “online English”, “children English”, “English picture books”, “English reading”, and “foreign teacher” were used to focus on the specific domain of online English learning for young learners.

The research’s approach to selecting the aforementioned keywords is strategic and comprehensive, reflecting the multifaceted nature of online English learning for young learners. To be specific, the reasons are as follows:

Firstly, the terms of “online English” and “children English” are essential as they directly address the core subject of the research—the online English learning experiences of young children. They form the basis for understanding the broader trends and interests in this domain.

Secondly, the terms of “English picture books” and “English reading” aim to examine the literacy aspect of language learning. This allows for an exploration of how parents and educators engage with and prioritize the reading and writing components of English education for children. It also provides insights into the resources they seek to support their children’s language development.

Thirdly, the term of “foreign teacher” is significant as it reflects the perceived value of native or fluent speakers in language learning. Parents and family educators may not be able to directly participate in their children’s listening and speaking practice, but they play a crucial role in seeking out and selecting resources and platforms that can enhance these skills. Analyzing search trends related to “foreign teacher” helps understand how parents are actively involved in finding solutions to support their children’s oral communication skills, despite their own limitations.

Last but not least, by analyzing the combined information, namely, the search trends for these keywords, the research can identify patterns and areas of interest among parents and educators. This information is vital for understanding the dynamics of online English learning and for making informed decisions on how to improve and adapt educational strategies. It helps in tailoring the content and methods of online English learning to better meet the needs and interests of young learners, as well as the expectations of stakeholders involved in their education.

### 2.2.1.3. Demographic Filters

To ensure the data was relevant to the study’s focus on young learners, demographic filters were set to include searches from users aged 19 and above, as these age groups are most likely to be directly involved in or affected by online English learning, with regard to English education and parental engagement.

### 2.2.2. Data Extraction and Preprocessing

Data extraction was performed using Baidu Index’s official API, which provided daily search volume indices for the selected keywords. Two content sections, namely, “trend research” and “user portrait” were extracted for data analysis.

The raw data was compared to the mean search volume for each keyword, to clearly present anomalies or outliers that deviated significantly from the means, so as to reflect the holistic spatiotemporal trend in this regard.

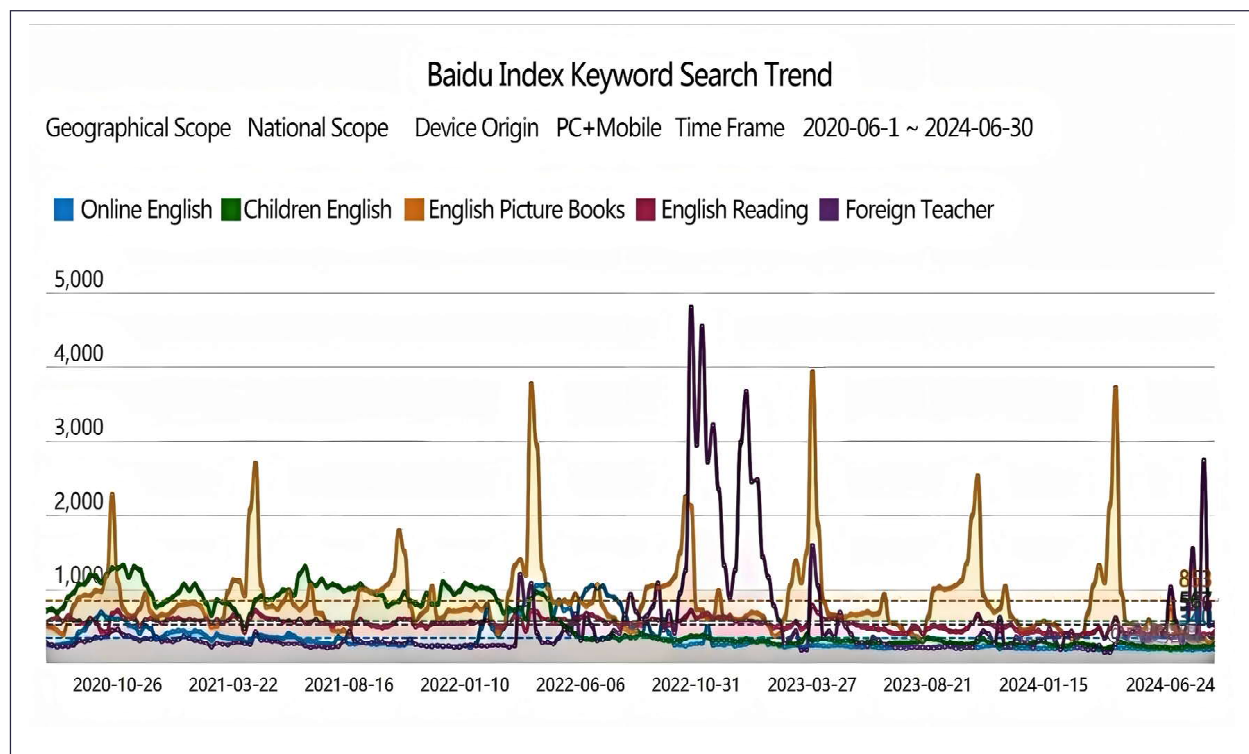
### 2.2.3. Ethical Considerations

The study adhered to ethical standards by ensuring that the data used was anonymized and in compliance with Baidu’s terms of service for data access.

## 3. Results

### 3.1. Overall Trends in Public Concern Over Time

The “trend research” section (Figure 3) presents the overall search index trends in public concern towards online English learning for young learners in China in terms of five specific dimensions, whether it’s mobile device or PC , as reflected by the Baidu Index data from 2020 to 2024. The data reveals a significant increase in public interest in “online English”, particularly during the early months of the 2022, followed by a steady decline towards the end of 2022. While with regard to “children English”, the data reveals a significant steady and robust increase before the early months of the 2022, covering the period of time from June, 2020 to February, 2022. In contrast to “online English” and “children English”, both the “English picture books” section and the “English reading” section generally stayed close to the average line, with the slight peaks showing a more distinct temporal pattern, typically reaching peak values within the two semesters of each year. The “foreign teacher” section shows a relatively low and stable trend with occasional spikes, notably around late 2021 to early 2022 and mid-2022, and particularly sharp around late 2022, and mid-2024, which stand out as significant anomalies against the otherwise low and consistent search index.



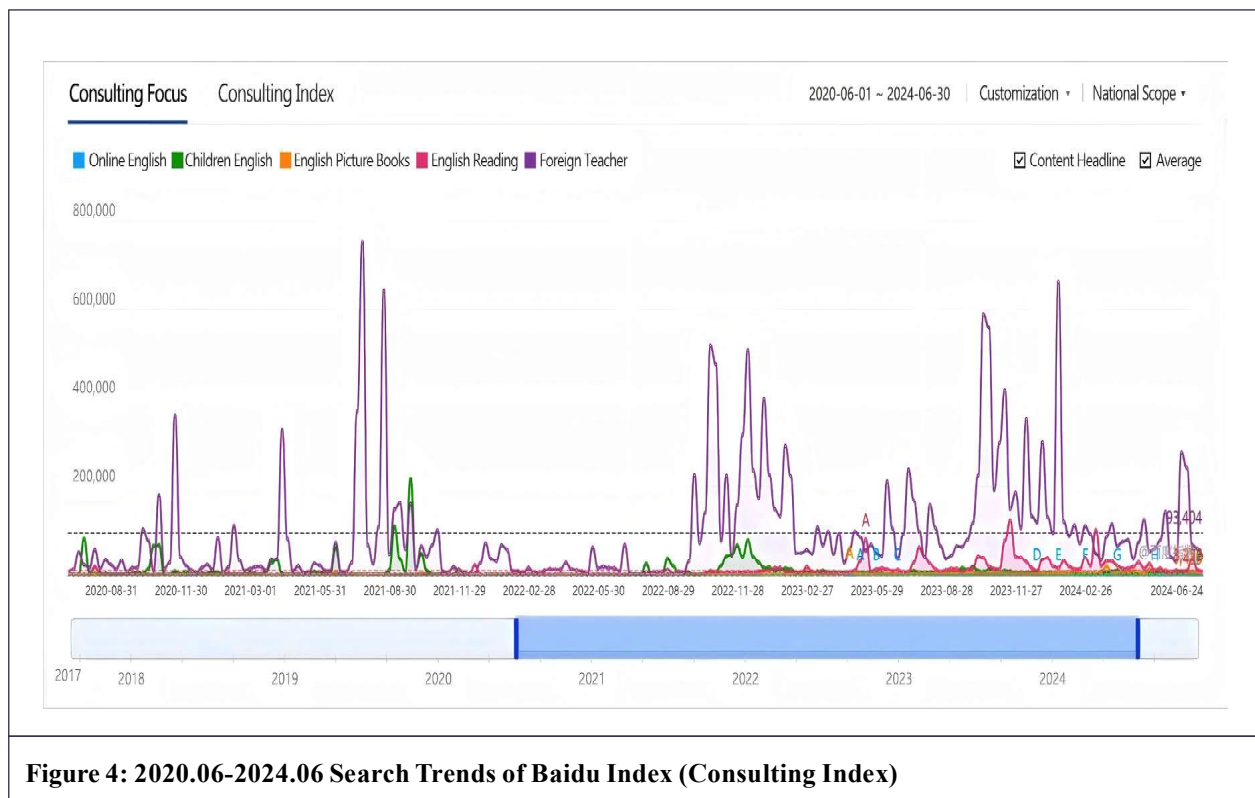
**Figure 3: 2020.06–2024.06 Search Trends of Baidu Index (Search Index)**

### 3.2. Visualizations

#### 3.2.1. Line Graphs

To visualize the temporal trends, based on Baidu’s intelligent distribution and recommendation content data, line graphs (Figure 4) were also used to plot the “Consulting Index” for the selected keywords over the five-year period. Together with the aforementioned “Search Index” (active search), it forms a closed loop, expressing and interpreting the level of netizens’ interest in the designated topics, from passive exposure to active search, using “active search plus content attention”. Calculated by weighting and summing the number of users’ reading, commenting, sharing, liking, and disliking behaviors, and then processing them through an indexation method, Figure 4 displays the overall trend of all the 5 aforementioned “key words” and zooms in on the temporal fluctuations within the time frame of the research, thus comprehensively measuring the extent of netizens’ passive attention to intelligently distributed and recommended content. Both indices (Figures 3 and 4) show that “children English” and “English picture books” are popular categories, but the timing of their peaks differs slightly between the search and consulting indices.

With regard to “foreign teacher”, it does not show a consistent spike pattern between the two indices, indicating that while there is interest in this category, it does not necessarily translate to the same level of passive content engagement as seen in other categories. Therefore, the overall trends suggest that while there is a general alignment in the interest levels for certain categories, the specific timing and intensity of interest can vary between active search behavior and passive content consumption. The peaks in passive searches for foreign teachers underscores a trend where learners, likely children, are seeking to enhance their spoken English abilities through direct interaction with native speakers or experienced teachers.



**Figure 4: 2020.06-2024.06 Search Trends of Baidu Index (Consulting Index)**

#### 3.2.2. Bar Charts

Bar charts were employed to present the monthly search volume indices for two dimensions, namely, “age distribution” and “gender distribution” as shown in Figure 5, highlighting the peak age groups and the gender variations with regard to different interest focuses. Restricted by the updating setting rules of Baidu Index, only the latest monthly data can be presented with regard to the 5 designated keywords, namely, “online English”, “children English”, “English picture books”, “English reading”, and “foreign teacher”. In respect to the research focus that lies in the spatiotemporal characteristics, the monthly data concerned can provide complementary data support for the detailed public concern. The data, while limited to a one-month period (October 1, 2024, to October 31, 2024), provides a snapshot of current trends that can be extrapolated to discuss broader patterns.

### 3.2.3. Maps

Spatial distribution of public interest in terms of online English, children English, English picture books, English reading and foreign teacher were mapped respectively (Figure 5, Figure 6, Figure 7, Figure 8 and Figure 9) to illustrate the regional differences in search volume indices, with hotspots indicating areas of high interest in online English learning.

According to the aforementioned map data, it can be seen that “Guangdong” consistently shows high interest across all categories, indicating a strong demand for English learning resources. “Jiangsu”, “Shandong”, and “Beijing” also exhibit high interest in multiple categories, suggesting a widespread engagement with English learning. Eastern and Central China regions, such as “Zhejiang”, “Henan”, and “Hebei”, are frequently highlighted, which may be due to the concentration of educational institutions and a focus on educational development in these areas. “Sichuan” appears in all figures, indicating a significant interest in English learning in the Southwest region. Therefore, all the regions mentioned above present consistent spacial patterns in the data extracted.

## 4. Discussion

### 4.1. Demographic Analysis

The demographic distribution of interest in online English learning reveals distinct patterns. The age distribution chart (Figure 5) indicates a significant engagement from the 30-39 age group, which could be attributed to parents seeking educational resources for their children, with the largest volumes across all sections, particularly in the “children English” section and the “English picture books” section. The 20-29 age group also shows a considerable interest, potentially representing young adults pursuing language skills for personal or professional development, with relatively high volumes both in the “English reading” section and the “foreign teacher” section.

Gender distribution (Figure 5) suggests a near-equal split in interest between males and females, with a slight edge for English picture books among females, indicating a possible preference for visual learning materials.

With regard to parental engagement, there is a pressing demand for additional research into targeted parental engagement strategies that can enhance student participation, as identified by various stakeholders (Dong *et al.*, 2023). The literature on parental involvement in children’s education often takes on a simulation nature, aiming to understand the impact of family engagement and specifically parental participation on English learning outcomes and motivation (Bizhu and Christopher, 2022; Naya *et al.*, 2023; Aili and Xin, 2023). These studies provide valuable insights into how family dynamics can influence a child’s educational journey. However, current approach, which leverages Baidu Index for demand analysis, offers a macro-level perspective on actual demand, representing a research methodology grounded in real-world data. This approach allows for the analysis of search trends and public interest over time, offering a more comprehensive understanding of the market dynamics and the factors driving the demand for online English education. By analyzing the demographic distribution of interest in online English learning through Baidu Index, we can identify distinct patterns, such as the significant engagement from the 30-39 age group, which is likely a group of parents looking for educational resources for their children. This real-world data complements the former simulation-based researches by providing a more accurate and current snapshot of the demand for online English learning, highlighting the importance of parental involvement in children’s education.

### 4.2. Contextual Interpretation

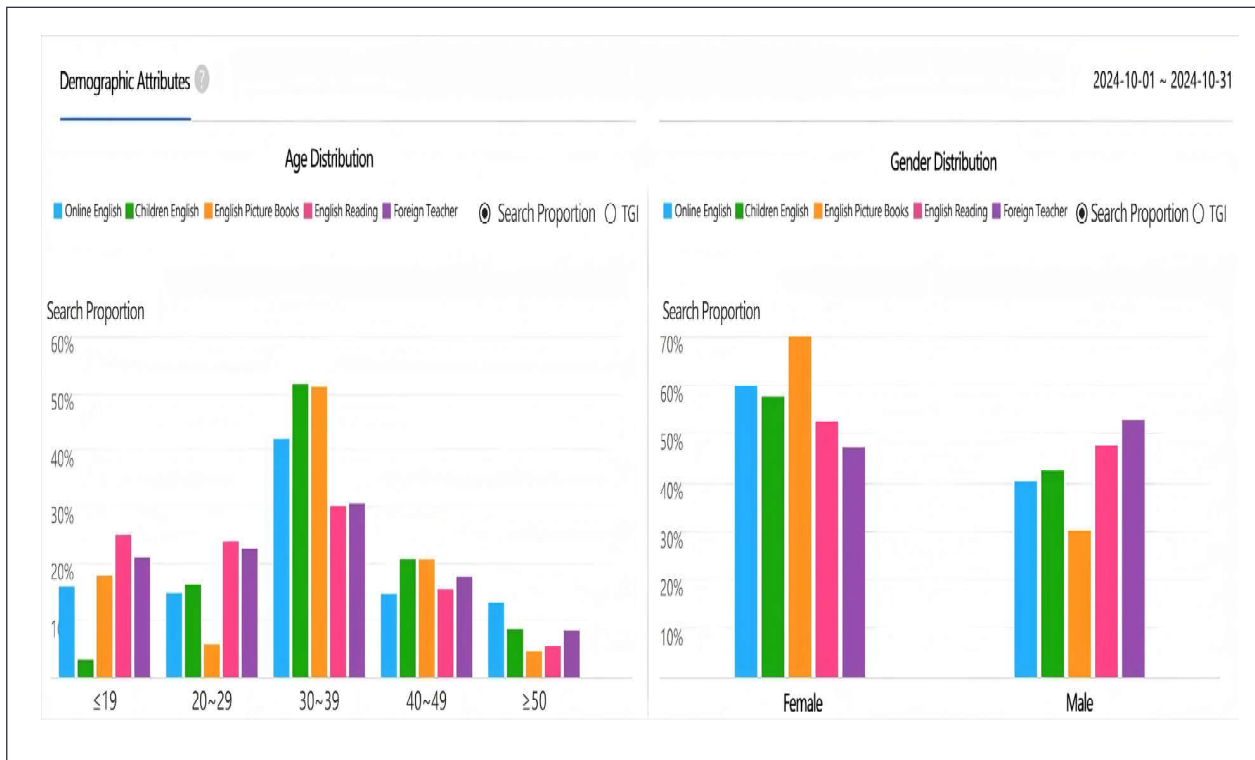
The observed increase in public concern during the pandemic through Baidu Index data aligns with global trends where online learning became a necessity. Literature on the rapid adoption of e-learning platforms regarding English for Young Learners globally during this period, particularly evident in the 2022 surge, supports our findings (Zaidatus *et al.*, 2023; Sabreena and Mohammad, 2023; Ivana, 2022; Tri *et al.*, 2022; Diana and Irma *et al.*, 2022; Made *et al.*, 2022; Veronica and Ramil, 2022). The trends depicted in Figure 3 and Figure 4 indicate that seasonal fluctuations in search volumes for English learning resources correspond with the academic calendar, reflecting increased parental engagement during school breaks.

### 4.3. Reasons Behind Trends

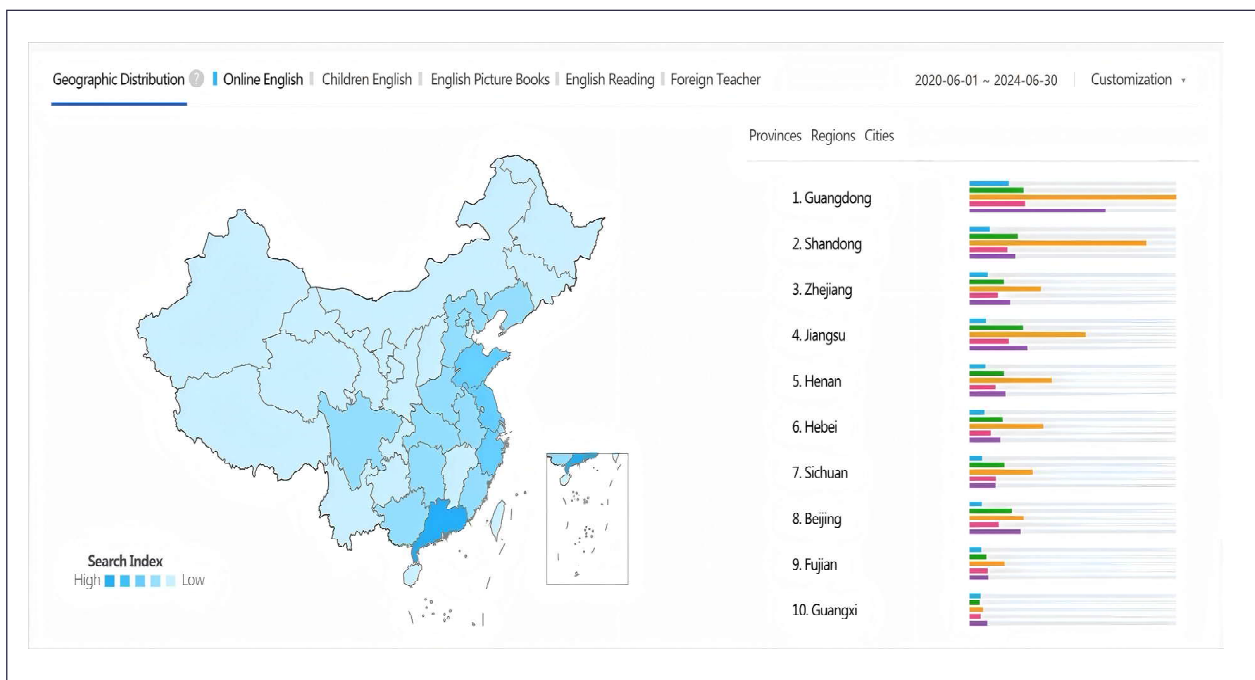
Several factors could explain the observed patterns. The spike in interest during school holidays and breaks might be attributed to the increased availability of time for learning activities, particularly regarding parental engagement. However, the spacial characteristics presented by the Baidu Index trends can be attributed to the reasons as follows:

### 4.3.1. Economic Reasons Behind the Spacial Patterns

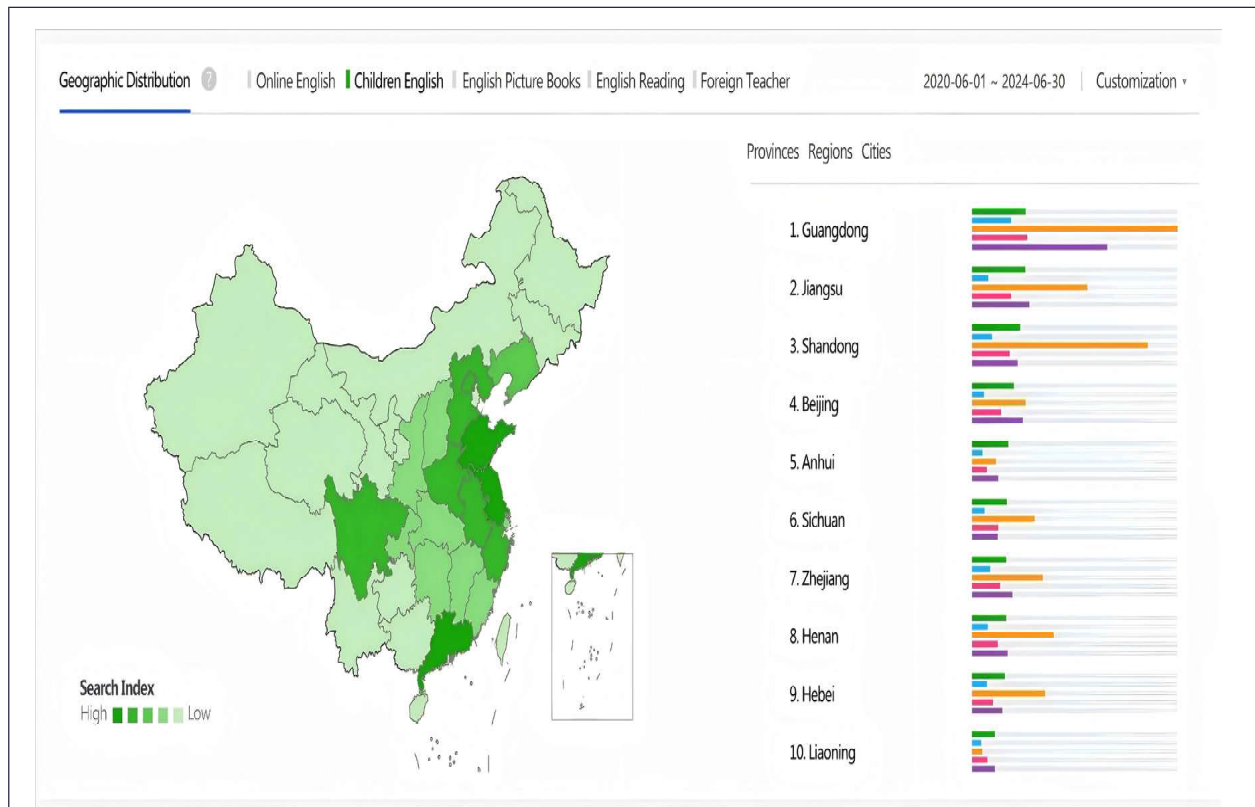
Based on the aforementioned 5 map figures (namely, Figures 5-10), concerning economic development, regions with higher growth, such as “Guangdong”, often have more resources and demand for English education to facilitate international business and trade. In addition, provinces like “Shandong” and “Zhejiang” have economies that are heavily reliant on exports. The need for English proficiency is integral to these industries to communicate with international clients and partners. According to Haining *et al.* (2017), “the returns to proficiency in English are higher in the coastal region, higher for women and evidence of education-language and skill-language complementarity” (p. 91). Based on



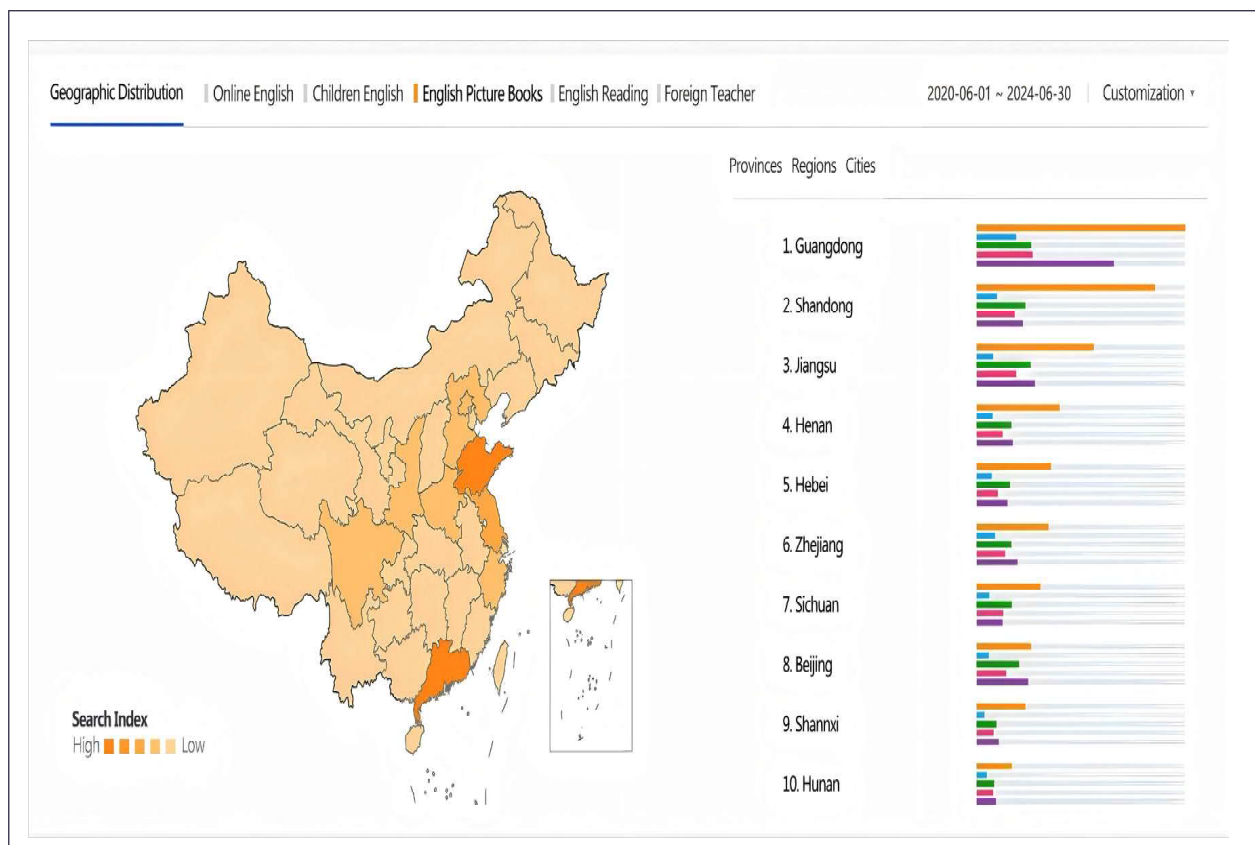
**Figure 5: 2024.10.01-2024.10.31 User Portrait of Baidu Index (Demographic Attributes)**



**Figure 6: 2020.06-2024.06 User Portrait of Baidu Index (Regional Distribution Regarding Children English)**

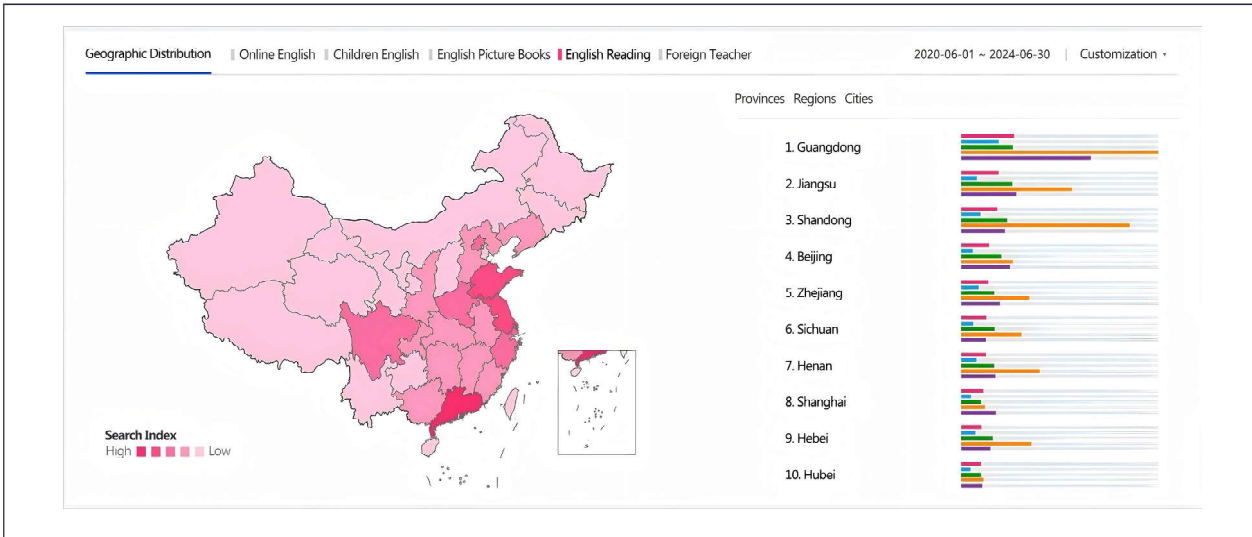


**Figure 7: 2020.06-2024.06 User Portrait of Baidu Index (Regional Distribution Regarding English Picture Books)**

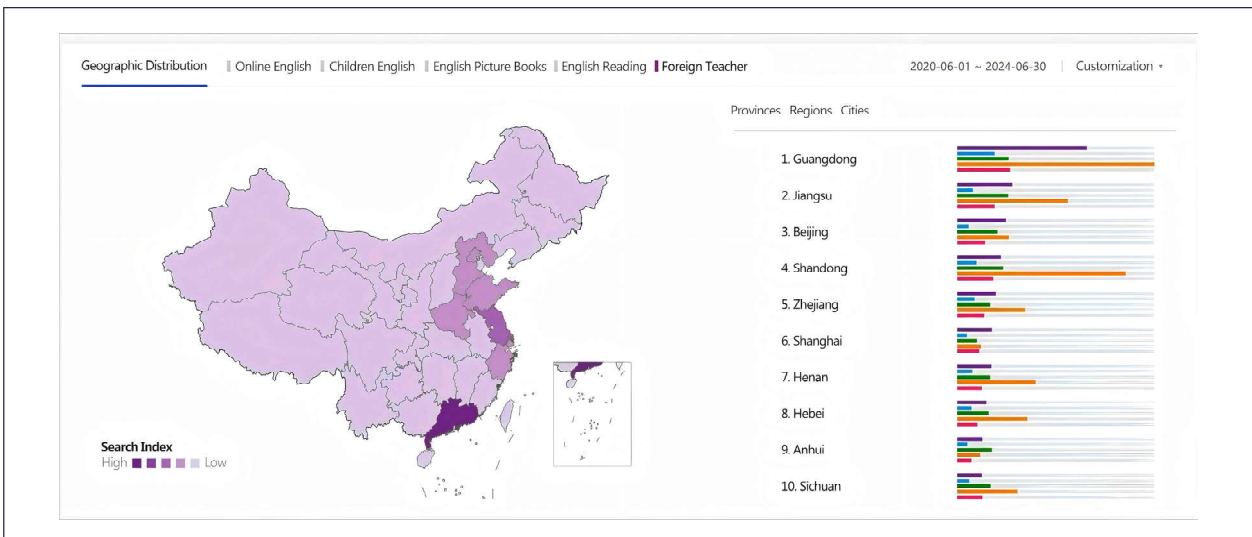


**Figure 8: 2020.06-2024.06 User Portrait of Baidu Index (Regional Distribution Regarding English Reading)**





**Figure 9: 2020.06-2024.06 User Portrait of Baidu Index (Regional Distribution Regarding English Reading)**



**Figure 10: 2020.06-2024.06 User Portrait of Baidu Index (Regional Distribution Regarding Foreign Teacher)**

the aforementioned data, it is obvious that “Guangdong”, “Shandong” and “Zhejiang” all belong to the coastal regions. Therefore, this economic driver likely contributes to the cultural importance of English and the high search volumes for online English learning resources.

With regard to the top three regions across all the 5 designated categories, the data shows an obvious alignment with that of the GDP ranking by Askci Consulting (Table 1), sourced from the Zhong Shang Intelligence Network,

Rank	Region	GDP Total (billion yuan)	Growth Rate
1	Guangdong	99939.18	3.40%
2	Jiangsu	97744.3	5.70%
3	Shandong	71981	5.60%
4	Zhejiang	62618	5.40%
5	Henan	47881.96	5.00%

Table 1 (Cont.)			
Rank	Region	GDP Total (billion yuan)	Growth Rate
6	Sichuan	45441.82	5.30%
7	Hubei	41655.01	5.70%
8	Fujian	40191.92	5.50%
9	Hunan	37898.74	4.50%
10	Anhui	37257	5.40%
11	Shanghai	34389.18	4.70%
12	Beijing	33462	5.10%
13	Hebei	32904	5.00%
14	Shaanxi	24781.13	4.60%
15	Jiangxi	24149.8	4.70%
16	Chongqing	23244.31	6.00%
17	Liaoning	22549.9	4.90%
18	Yunnan	22110.03	3.00%
19	Guangxi	20351.72	3.60%
20	Inner Mongolia	17875.5	5.80%
21	Shanxi	17532.53	1.80%
22	Guizhou	16052.9	5.20%
23	Xinjiang	14547.67	5.50%
24	Tianjin	12673.87	4.70%
25	Heilongjiang	10777.8	2.30%
26	Jilin	10116.13	4.10%
27	Gansu	9126.3	6.00%
28	Hainan	5583.55	3.20%
29	Ningxia	3860.43	4.90%
30	Qinghai	2741.19	2.50%
31	Xizang (Tibet)	1785.74	6.20%

leveraging its robust big data analytics to offer authoritative industry insights and research. Combined with this data, it shows that provinces with higher GDP and growth rates tend to have a greater demand for English education, reflecting the potential need for English proficiency in business, technology, and international communication. With regard to resource allocation, economically stronger provinces can allocate more resources to English education, potentially leading to higher quality education and more diverse learning opportunities. In addition, regarding policy focus, regions with lower GDP might focus on basic English education to improve overall literacy and economic mobility, while wealthier regions can afford to invest in specialized English programs, thus from the perspective of social-economic status (SES), the data provides a holistic view of how economic factors influence English education policy and demand across China.

4.3.2. Population Density Reasons Behind the Spacial Patterns

According to the “Bulletin of the Seventh National Population Census (No. 3)—Regional Population Situation” (Table 2) by the Office of the Leading Group of the Seventh National Population Census of the State Council and the National Bureau of Statistics in 2021. Compared with the sixth national population census in 2010, among the 31 provinces, there are 25 provinces with an increase in population. The top 5 provinces with the most population growth are “Guangdong”, “Zhejiang”, “Jiangsu”, “Shandong”, and “Henan”. These 5 provinces’ consistent spacial patterns are indicated by the aforementioned Baidu Index results, and align with the regional GDP rankings provided by Askci Cosulting. National Bureau of Statistics in 2021. Compared with the sixth national population census in 2010, among the 31 provinces, there are 25 provinces with an increase in population. The top 5 provinces with the most population growth are “Guangdong”, “Zhejiang”, “Jiangsu”, “Shandong”, and “Henan”, which are obviously in alignment with that of the consistent spacial patterns by the Baidu Index and that of the regional GDP ranking by Askci Consulting.

**Table 2: Data on the Permanent Population of 31 Provinces, Autonomous Regions, and Municipalities Directly Under the Central Government (Hereinafter Referred to as Provinces) in China’s Mainland as of 00:00 on November 1, 2020, by the Results of the Seventh National Population Census in 2021**

			Unit: Person,%
	Region	Population	Proportion
<b>National Scope</b>	1,411,778,724	100	100
Beijing	21,893,095	1.55	1.46
Tianjin	13,866,009	0.98	0.97
Hebei	74,610,235	5.28	5.36
Shanxi	34,915,616	2.47	2.67
Inner Mongolia	24,049,155	1.7	1.84
Liaoning	42,591,407	3.02	3.27
Jilin	24,073,453	1.71	2.05
Heilongjiang	31,850,088	2.26	2.86
Shanghai	24,870,895	1.76	1.72
Jiangsu	84,748,016	6.00	5.87
Zhejiang	64,567,588	4.57	4.06
Anhui	61,027,171	4.32	4.44
Fujian	41,540,086	2.94	2.75
Jiangxi	45,188,635	3.20	3.33
Shandong	101,527,453	7.19	7.15
Henan	99,365,519	7.04	7.02
Hubei	57,752,557	4.09	4.27
Hunan	66,444,864	4.71	4.9
Guangdong	126,012,510	8.93	7.79
Guangxi	50,126,804	3.55	3.44

<b>Table 2 (Cont.)</b>			
	<b>Region</b>	<b>Population</b>	<b>Proportion</b>
	Hainan	10,081,232	0.71
	Chongqing	32,054,159	2.27
	Sichuan	83,674,866	5.93
	Guizhou	38,562,148	2.73
	Yunnan	47,209,277	3.34
	Xizang (Tibet)	3,648,100	0.26
	Shaanxi	39,528,999	2.80
	Gansu	25,019,831	1.77
	Qinghai	5,923,957	0.42
	Ningxia	7,202,654	0.51
	Xinjiang	25,852,345	1.83
	Active Duty Military Personnel	2,000,000	

Therefore, it can be deduced that areas with higher population densities, like “Guangdong”, “Jiangsu” and “Shandong”, potentially have a larger number of learners, thus increasing the search volume for English learning resources (Figures 5-8). The data supports this by showing that the population in the eastern region has increased significantly. The increased population density in these areas could indeed lead to a higher demand for English learning resources due to the larger potential learner base.

#### 4.3.3. Educational Priority Reasons Behind the Spacial Patterns

Figure 9 shows that regions like Beijing and Shanghai, which are centers of higher education and research, also have high search volumes for “foreign teacher”, thus making these two global metropolitan cities rank top 3 and top 6 respectively, which stand out as significant anomalies against the otherwise low and consistent search index ranking. This reflects a cultural value placed on education and the pursuit of knowledge, where English is seen as a critical tool for accessing global academic resources and participating in the international scholarly community, particularly in respect to English listening and speaking skills. Therefore, regions with more educational resources, including foreign teachers and English learning materials, may naturally have higher interest regarding availability of resources.

According to the study conducted by Qiufang and Hong (2020), the market economy has influenced English teaching, and the public’s dissatisfaction with English teachers in the public education system, thus leading to curriculum reforms (pp.113-133). Therefore, utilizing big data from platforms such as Baidu Index to uncover the genuine market demand for English listening and speaking proficiency in major cities like Beijing and Shanghai is of paramount importance. This empirical methodology offers a concrete indication of public interest and demand, effectively presenting the specific reform direction for curriculum reforms. By examining trends and search volumes for keywords including “foreign teacher” and “online English”, the research reveals real-world needs that might not be entirely reflected in policy-driven assessments. It exposes regional variations in educational demands, evaluates the efficacy of current educational policies in addressing market demands, and offers forward-looking insights into future educational trends. The research not only emphasizes the significance of listening and speaking skills in the era of globalization but also delivers actionable insights for policymakers and educators to improve English education quality, allocate resources more effectively, and align policy with practical educational needs.

#### 4.3.4. *Cultural Exchange and Tourism Reasons Behind the Spatial Patterns*

The area with a rich history of cultural exchange and tourism, particularly Sichuan, is across all the 5 designated categories based on the aforementioned 5 map figures, exhibiting moderate search volumes. With increasing exposure to the local environment, tourists are facing higher linguistic expectations in their interactions with the host community. Language barriers might hinder tourists' decision making and diminish their travel enjoyment (Mancini-Cross *et al.*, 2009). Therefore, the cultural emphasis on English in these regions is likely driven by the need to communicate with international visitors and to preserve and share their cultural heritage on a global stage.

#### 4.4. *Correlation with External Factors*

The data also showed a correlation between public concern and external events such as national education policy changes and the impact of the pandemic on traditional classroom learning, and the like.

##### 4.4.1. *Impact of the COVID-19 Pandemic*

The Baidu Index trends from June 2020 to June 2024 reveal significant spikes in search volumes for "online English" and "children English", particularly during the early stages of the Covid-19 pandemic. This surge in interest aligns with the period when traditional classroom learning was disrupted, and families sought online alternatives.

##### 4.4.2. *Influence of National Education Policy Changes*

"China's Online English Education Market Report for Children and Adolescents in 2020" released by Key Laboratory of Big Data Mining and Knowledge Management of Chinese Academy of Sciences indicates that national policies have played a pivotal role in the online English education sector. The introduction of regulatory measures in 2019, as noted in the report, likely contributed to the fluctuations observed in the Baidu Index, especially in the "foreign teacher" section, reflecting industry adaptation to new regulatory standards.

##### 4.4.3. *Seasonal Variations and Academic Calendar*

The recurring peaks in search trends for "English picture books" and "English reading" coincide with school semesters and holidays, as seen in the Baidu Index data. This pattern suggests that parental interest in supplementary English learning materials increases during periods when children are out of school, aiming to maintain or enhance their language skills.

##### 4.4.4. *Technological Advancements and Accessibility*

The growing interest in "English reading" and "children English", as indicated by the Baidu Index, may also be attributed to the overwhelming advancements in digital technology and increased accessibility to online platforms. The data reflects a general upward trend in these categories, indicating a rising demand for online English learning resources as technology becomes more integrated into education.

##### 4.4.5. *Socioeconomic Factors and Urban-Rural Divide*

According to the "Statistical Report on China's Internet Development 2024" from the China Internet Network Information Center (CNNIC), the market analysis suggests that urban areas, especially in top-tier cities, are the primary consumers of online English education, reflecting the urban-rural divide. The Baidu Index data supports this by showing higher search volumes from regions with larger populations and more developed economies, indicating that socioeconomic status and geographical location are significant factors influencing the adoption of online English learning, particularly with regard to the huge gap between the urban and rural areas.

In summary, the Baidu Index data reveals the intricate dynamics among policy, technology, societal factors, and external events in shaping the demand and accessibility of online English education. The data shows a complex pattern of public interest in online English learning for young learners, which is influenced by a multitude of temporal, spatial, and external factors. The adaptability of the online education sector to challenges like the pandemic, as indicated by search trend spikes, underscores the importance of digital infrastructure in supporting educational initiatives. Furthermore, the emphasis on English learning in certain regions reflects their internationalization efforts, economic engagement, educational aspirations, and cultural exchange, which are key drivers behind the high search volumes observed. In essence, the spatiotemporal characteristics of public concern towards online English learning are a product of a combination of cultural, economic, and social factors, highlighting the multifaceted cultural significance of English in contemporary China.

## 5. Conclusion

This study, leveraging Baidu Index data, has unveiled the spatiotemporal characteristics of public interest in online English learning in China, noting a surge in interest during the pandemic that later declined by the end of 2022, reflecting the dynamic nature of public sentiment in digital education. There is a higher level of concern in the eastern regions compared to the west, with parents and educators being significant contributors to search volume. Understanding these spatial and temporal nuances is crucial for educators and policymakers to adjust educational programs to meet the needs of young learners and to enact regulations that enhance the quality and accessibility of online English learning. Future research should further explore the long-term impact of public interest on the quality and accessibility of online learning platforms, as well as conduct comparative analyses across regions or nations to reveal global trends and contributing factors. Additionally, studying the effectiveness of various online learning platforms and pedagogical approaches, especially in the context of parental engagement, is essential. Ultimately, this study highlights the complex interplay of cultural, economic, and social factors in shaping the spatiotemporal characteristics of public interest in online English learning and calls upon educators, policymakers, and industry stakeholders to consider the multifaceted implications of public concern and to use data-driven insights to shape the future of online English education in China.

## 6. Implications

### 6.1. Implications for Educators

Based on the above analyzes, school educators should consider the cyclical nature of public interest when planning online English learning programs, ensuring they are responsive to seasonal demands and able to engage students during peak interest periods. To ensure the learning continuity of YELs, school educators must build on what children learnt in their FL in preschool (Mihaljevi and Nikolov, 2019), thus systematic children-centered approaches are indispensable facing the substantial heterogeneity of proficiency levels among learners (Maria, 2024).

Family educators, when it comes to parental engagement, are uniquely positioned to select age-appropriate materials and activities for their children, particularly using the English picture books (Maria, 2024), because they possess the deepest understanding of their offspring's needs and capabilities. By leveraging this intimate knowledge, family educators can tailor educational experiences that not only align with their children's developmental stages but also foster a love for learning and exploration. This personalized approach is crucial for nurturing cognitive, social, emotional, and physical well-being, which are essential for a child's holistic development. Therefore, the objectives of family-based online programs should transcend the narrow focus on specific language gains, encompassing a broader range of developmental domains. These include attitudes, motivation, self-confidence, and beliefs, as highlighted in studies by Mihaljevi and Nikolov (2019) and Nikolov and Mihaljevi (2006; 2011). While these domains are more challenging to quantify and evaluate, they are crucial for shaping long-term outcomes and should be considered as integral components of preschool education. The primary benefits of preschool programs, therefore, lie in their capacity to foster these holistic developmental aspects, which may have a more significant and lasting impact on children's futures than mere linguistic proficiency.

Regarding parental engagement, in addition to engaging with research literature, parents who are involved in their children's online English learning should embrace the digital era by leveraging big data platforms such as Baidu Index to capture trends in relevant data. Baidu Index allows users to conduct keyword data accumulation searches, which can aggregate data from multiple keywords into a composite keyword, providing a broader view of search trends. This functionality is particularly useful for family educators as it enables them to understand the aggregated interest in different aspects of English learning, such as specific teaching methods or learning resources.

Moreover, Baidu Index offers the ability to perform searches for specific regions and time periods, which can help parents identify localized trends and shifts in English learning interests and demands. This regional and temporal data can be invaluable for tailoring educational approaches that are sensitive to the cultural and educational contexts of their children.

By utilizing big data platforms like Baidu Index, parents can gain a more nuanced understanding of the English learning landscape, which can inform their decisions on educational materials and activities. This data-driven approach complements traditional educational methods and ensures that family education remains relevant and effective in the digital age.

### 6.2. Implications for Policymakers

Policymakers should utilize big data analytics, such as those provided by Baidu Index, to understand the pulse of public opinion and trends within the online education space. This data can guide policy formulation, ensuring that new

regulations are in tune with current educational shifts and public expectations. By keeping a finger on the pulse of online trends, policymakers can proactively shape policies that foster a supportive environment for the growth of online education, thereby increasing the likelihood of positive public reception and sector development.

### 6.3. Implications for the Industry

The education sector must be agile in responding to fluctuating public interests, as indicated by big data trends. By investing in adaptable technologies and educational methodologies that can expand rapidly to accommodate surges in demand, the industry can uphold educational standards even during peak engagement periods. Big data insights, like those from Baidu Index, can reveal upcoming trends, enabling the industry to innovate and scale its offerings effectively. This proactive approach to data-driven decision-making is crucial for maintaining a competitive edge in the rapidly evolving field of online education.

## 7. Limitations

For one thing, it is important to acknowledge that the Baidu Index data, while comprehensive, may not fully represent the entire population's interest due to potential biases. For instance, Baidu's user base is predominantly urban and may not accurately reflect rural areas' perspectives on online English learning.

For another, the demographic filters applied to the data, although focusing on users above 19 may include YELs' parents and educators, it impacts the research's scope regarding the primarily young learners and their immediate circle, such as peers and companions. This exclusion of certain societal perspectives might affect the generalizability of the findings. Additionally, with regard to Figure 5, the temporal constraint to a single month may not fully capture the dynamic nature of public concern, which can fluctuate with seasonal variations, educational cycles, and significant events, as it is based on Baidu Index, which may have biases towards certain demographics or regions with higher internet penetration within certain time frames.

Last but not least, it is important to acknowledge the limitations of the data functions presented. In the scope of this study, two principal functionalities of Baidu Index were chosen, namely, "trend research" and "user portrait", which are instrumental in reflecting the spatiotemporal characteristics of public interest. Despite their robustness and efficacy, these tools have been selected for their specific relevance to our research objectives. The complexity and intricacy of the demand map, which offers a comprehensive overview of search demand, will be reserved for future investigation to allow for a more in-depth analysis and application. This decision reflects the limitations of our current study, where the exploration of the demand map's full potential will be pursued in subsequent research endeavors.

Despite these limitations, the data provides valuable insights into the current landscape of online English learning interest. The trends observed can serve as a foundation for further research, potentially incorporating longitudinal studies or a broader temporal scope to enhance the understanding of spatiotemporal characteristics.

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