

A Knowledge Graph-Based Approach to Analyzing the Construction of Urban Cultural Images and Multi-Level Symbolic Flows in Translanguaging Practice

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ABSTRACT

In this paper, on the basis of relevant theories, based on the adversarial training of BERT-PGD-BiLSTM-CRF entity recognition model and relationship extraction technique to complete the entity extraction and relationship extraction, and then use the entity linking method that fuses attribute and semantic features (BERT+CBOW+CLS) to complete the construction of the knowledge graph and the supplementation of the knowledge graph, and the data is imported into the Neo4j Storage and Display. The symbols contained in the above knowledge graph for the city cultural image in translanguaging practice are divided into three hierarchical symbols, and the symbols are analyzed in terms of flow. In terms of single language usage, English has the highest proportion (22.57%), and Chinese has the best proportion (63.19%) in the process of urban cultural image construction, highlighting the dominant position of Chinese in urban cultural image construction. During the twenty-year period from 2004 to 2023, the trend of social behavioral symbols growth is significantly higher than that of material and spiritual symbol layers, which fits well with the current social development trend.

Keywords: knowledge graph, translanguaging practice, recognition model, multilevel symbols

1. Introduction

The term translanguaging was first used in the 1980s by Cen Williams, a leading Welsh educationalist, to refer to the planned and systematic use of two languages for teaching and learning within the classroom [1]. The suffix *ing* in Translanguaging indicates that human linguistic activity is ongoing, emphasizing the ability of language users to use their symbolic resources subjectively and strategically for communication and other behaviors, while the prefix *trans* indicates that it transcends linguistic boundaries and breaks down the traditional barriers between disciplines [2-3]. The concept of translanguaging has expanded from the initial teaching strategy to other fields such as sociolinguistics, evolving into a theoretical framework that goes beyond linguistic structure [4]. Among them, the

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research on translinguaging under the perspective of sociolinguistics mainly includes expanding the theoretical framework of translinguaging, focusing on language practices in daily communication, and the integrated application of linguistic and non-linguistic resources in the process of meaning making, such as the construction of social differences across urban spaces [5-7].

The 21st century is an era of great urban competition, more and more cities begin to utilize cultural activities to improve their image, stimulate urban development, attract tourists and investment, cultural representation, cultural diversity and social inclusion have become the top priority of urban construction, the construction of urban cultural image is more critical than ever. Urban image is an important asset of the city, which not only affects the city's economy, social development, culture, and residents' life, but also relates to the city's ability to integrate all kinds of resources, and to the development of the city as a whole [8-10]. City image is the external expression of the city, which is an important reflection of the city culture and city vitality. City image is the shape and characteristics of the city that can stimulate people's thoughts and feelings, and it is the specific perception, overall view and comprehensive evaluation of the city's internal strength, external vitality and development prospects by the public inside and outside the city [11-13]. In the historical process of building a harmonious society, shaping and maintaining a harmonious city image is an important part of urban construction all over the country.

The culture of a city is people's overall cognition and impression of the cultural temperament of a city, which comes from the philosophy of urban development, urban spirit, public cultural space, cultural landscape and so on. As urban culture carries the humanistic history and cultural spirit of the city, it shapes the image of the city, enhances the cognition of the city, expresses the connotation of the city, and interprets the characteristics and essence of the city with an intangible and inner power. Urban cultural image is becoming a living "business card" of the city, which is the most direct and vivid display of the city's temperament and connotation.

In this paper, we first define knowledge graph and translinguaging, and considering that building knowledge graph for urban cultural image is a complex process, we propose to use BERT-PGD-BiLSTM-CRF entity recognition model based on adversarial training to realize entity extraction and relationship extraction, and then use entity linking method (BERT+CBOW+CLS) that integrates attributes and semantic features to complete the design task of knowledge graph. Completing the design task of knowledge graph, it complements the application of knowledge graph in the construction of urban cultural image. The keywords in the knowledge map are divided into material symbol layer, spiritual symbol layer, and social behavior symbols, and finally the symbol dissemination path and evolution trend are analyzed.

2. Analysis of urban cultural image construction and multi-level symbolic flow

2.1. Relevant theoretical foundations

2.1.1. Knowledge mapping. A knowledge graph is a knowledge base consisting of a number of entities with different attributes, and different relationships between different entities in a mesh [14-15]. From the perspective of graph, knowledge graph is comparing the people and objects in the real world as one entity in the graph, and their relationships in the real world as edges between the entities, so that it seems that knowledge graph is also a symbolic expression of the real time, which is more clear and concise mapping the semantic network of the objective world, and represents the connection of the real world with simple nodes and edges [16-17]. The knowledge graph can be understood as a heterogeneous information network containing entities (nodes) and relationships (directed edges), denoted by $G = \{V, E\}$, with $V = \{P\}$ representing the set of entities in the knowledge graph and E representing the set of edges.

2.1.2. *Translanguaging.* Translanguaging as a theory of practice considers human linguistic practices as a product of cultural evolution and socialization. Translanguaging includes the ability to distinguish between the structural features of different languages and the historical, political and ideological connotations associated with these languages. Thus, a multilingual person is aware of the political attributes and socio-cultural connotations of different languages and has the ability to acquire and use certain structural features of the language they have acquired in a particular community. It is important to note that the translanguaging practices should be seen more as a practical process involving multiple languages and linguistic variants rather than as a physical structure to be identified and analyzed. It is a process of knowledge construction that utilizes language and goes beyond it, representing an effective way of communication that emphasizes function over form. At the same time, translanguaging is also a process of cognitive and socio-cultural activities and linguistic outputs. The prefix *trans-* in the concept of translanguaging, put together with the suffix *-ing*, suggests that language is not just a set of codes, but also a dynamic process of meaning construction, which changes our understanding of linguistic form. Translanguaging highlights the creativity and criticality of multilingual speakers, where creativity is reflected in the ability to make choices in adhering to or breaking the rules of behavior, including language use, and the ability to push and break the boundaries between the old and the new, the traditional and the original, the conventional and the unconventional.

2.2. *Construction of urban cultural image in translanguaging practice based on knowledge mapping*

In the domain of translanguaging, constructing a knowledge graph oriented to the cultural image of a city is a complex process, which contains the following steps: entity extraction and relationship extraction are accomplished by the BERT-PGD-BiLSTM-CRF entity recognition model based on adversarial training and the relationship extraction technique, and entity linking method (BERT+CBOW+CLS) using fusion of attributes and semantic features is accomplished to Constructing the knowledge graph and supplementing the knowledge graph. Finally, the data is imported into Neo4j for storage and display.

2.2.1. *Adversarial Training Based Named Entity Recognition Models.* Due to the excellent performance of deep learning technology in named entity recognition, this paper constructs a named entity recognition model based on adversarial training based on the features of urban cultural image text. Firstly, the well-segmented urban cultural image text is used as the input to the BERT (Bi-directional Encoder Representation Method) coding layer and pre-training is realized to generate the feature vectors of each word. Then it is input to BiLSTM (Bidirectional Long Short-Term Memory Network) layer for contextual feature extraction to learn the deep features, and finally goes through CRF (Conditional Random Field) layer to complete the sequence labeling and get the group with the highest probability in the labeled sequence. The model structure consists of 3 parts, Embedding layer, BiLSTM layer and CRF layer.

The specific process of named entity recognition model based on adversarial training is as follows:

Step 1: Literature Data Acquisition Based on a database, we retrieve 7807 journal articles from all databases with the subject term “translanguaging” and “urban culture”, and manually eliminate the irrelevant information of the research topic, so as to obtain 7444 valid articles. Among them, there are 1639 core papers, and the text of urban cultural image and translanguaging is preprocessed to get the labeled corpus at the single-word level, which is then cut into pieces to build the training corpus, validation corpus and test corpus required for the experiments, and then the obtained corpus is input into the BERT embedding layer.

Step 2: The BERT embedding layer carries out a vectorized representation of the corpus of step 1 at the single-word level, and obtains a feature expression vector of words.

Step 3: The word vectors obtained in Step 2 are added with the perturbation values computed according to the projected gradient descent (PGD) algorithm to obtain the adversarial samples.

Step 4: The antagonistic samples obtained in Step 3 are input into BiLSTM in both forward and reverse order to obtain the forward and backward state values, respectively, and the two state values are spliced with each other to obtain the final eigenvector expression.

Step 5: Input the feature vectors obtained in Step 4 into CRF, calculate the text probability of urban cultural image under different labels through the state matrix and transfer matrix, and obtain the final output label.

2.2.2. Entity Linking with Fused Attributes and Semantic Features. Firstly, entity recognition or entity extraction techniques are utilized to extract the entities that need to be linked in the text of the city's cultural image. Secondly, a set of candidate entities based on association relationships is extracted from the knowledge base. Finally, an entity linking model is established to analyze the similarity between the linked entities and the candidate entities, and select the object with the maximum similarity as the linking object, which is also called entity disambiguation. In order to solve the problems of current complex models that lead to computational inefficiency, the need for a large amount of data for training, and the rare consideration of entity context and semantic relationships, this paper proposes an entity linking method that fuses attributes and semantic features, which is specifically denoted as BERT (Bi-directional Encoder Representation Method) + CBOW (Continuous Bag of Words Model) + CLS (Categorical Labeling Signifier). By building a model that fuses attributes and semantic features with the candidate entity classification task as an auxiliary task for entity disambiguation, the auxiliary task improves the probability that the target entity is linked to the correct candidate entity. At the same time, the attribute information of candidate entities is added to further enhance the generalization ability of the model for entity disambiguation and improve the processing effect of the model in entity disambiguation task.

2.2.3. Knowledge storage and presentation. Neo4j is a graph database that uses graphs (nodes and edges) to store and process data. Unlike traditional relational databases, the data model of graph databases can better represent complex relationships and connections, and thus graph databases are usually more efficient and flexible than traditional databases when dealing with large-scale, highly correlated data. In this paper, the knowledge graph is imported into the Neo4j graph database so as to store and display, the specific steps are as follows:

- 1) Organize the text corpus of urban cultural image and convert the corpus format to JSON format.
- 2) Connect to the Neo4j platform.
- 3) Create relationships between entities.

The above-mentioned construction of the knowledge graph emphasizes that human beings can deliberately break the boundaries of language and make the cultural image of the city more profound. For example, in the "Han GAI (Street) Market" built during the National Day, the language landscape designer used the Chinese pinyin alphabet (GAI) to spell out the Wuhan dialect "street" (gāi) on the lintel. The tagline "Flower Young Wuhan" utilizes the English word "young" instead of the Chinese character "样", which indicates that the bazaar has a wide variety of products and suggests that the main consumers of the bazaar are young people. Another example is the slogan in front of a store, "I haven't seen you for a long time, what are you doing?" (I haven't seen you for a long time, what are you doing?) The slogan greets passers-by in Wuhan dialect, which on the one hand expresses the regret of not being able to open the door to customers during the epidemic, and on the other hand, expresses the anticipation of new and old friends. The designers used different forms of linguistic resources according to different communicative purposes. The use of English highlights the international stance of Han Street, while the embedding of Wuhan dialect strengthens the local identity, making the linguistic landscape a cultural image of the city.

2.3. Knowledge Graph-based Multilevel Symbolic Flow for translanguaging texts

2.3.1. Hierarchy of symbols. The symbols contained in the above knowledge map of urban cultural image oriented to translanguaging practice are divided into different levels, such as the material symbol layer (including architecture, clothing, cuisine, etc.), the spiritual symbol layer (such as values, beliefs, artistic style, etc.), and the social behavioral symbols (such as folklore activities, social etiquette, etc.). By analyzing the symbols of each level, we understand their role and interaction relationship in the communication of urban cultural image.

2.3.2. Symbol dissemination paths. Utilizing the relationship network in the knowledge graph, we track the propagation path of symbols across different media, and across different geographic regions in different populations. For example, analyze how a city's characteristic food spreads on social networks through tourists' sharing and media reports, and influences people's perception of the city in other regions.

2.3.3. Trends in symbol evolution. Based on the historical data in the knowledge graph and the law of symbol propagation, the evolution trend of symbols in the future city cultural image is predicted, which helps to plan in advance the strategy of city culture construction and image promotion to fit the social development and the change of people's aesthetic concept.

3. Example Analysis of Urban Cultural Image Construction and Multi-Level Symbolic Flow

3.1. Analysis of the construction of a knowledge map for the city's cultural image

3.1.1 Exploring Urban Culture in Translanguaging Practice. With the central cultural district is located in the core of a city, set cultural communication, tourism, catering, shopping, office, residential and other functions in one. As the core of this cultural district, the stores on both sides of Street A are mainly in the Republican style, with modern and European buildings dotting the landscape. The data samples in this subsection come from the exhaustive photography of the signage and all text carriers on both sides of Street A. The author sampled twice in June and December 2023, obtaining a total of 374 photographs and 39 videos, and after removing linguistic entities with duplicated content or similar functions, 226 units of analysis were finally obtained. In this paper, we first use Excel tables to make preliminary statistics on the specific characteristics of the kinds and numbers of language use in the units of analysis, and then analyze the data qualitatively by comprehensively applying the theory of linguistic landscapes and translanguaging.

1) Types and distribution of language use. The kinds of language use are shown in Table 1. It can be seen that more than 35.00% of the urban cultural signs in Street A are monolingual, and more than half of the urban cultural signs are bilingual, however, there is only one case of trilingual urban language landscape.

Table 1. Types of language use

Type of sign	Quantity	Proportion
Monolingual	82	36.28%
Bilingualism	127	56.19%
Trilingual	17	7.52%
Total	226	100.00%

The distribution of language use is shown in Table 2. The overall distribution of languages shows that English has the highest percentage (22.57%) in terms of single language use. There are no longer a few stores that use a foreign language alone as a signboard (25.22%), and the vast majority of the foreign languages used contain for. Although the official language policy regulates the use of language in language practice, the actual use of language may differ or even conflict with the language policy due to factors such as language identity and the fact that English is a strong language in the context of globalization.

Table 2. Language usage distribution

Language distribution	Quantity	Proportion
Chinese only	36	15.93%
English only	51	22.57%
Chinese and English (or in reverse order)	116	51.33%
Chinese and Japanese (or in reverse order)	6	2.65%
Chinese and Danish (or in reverse order)	4	1.77%
English and French (or in reverse order)	4	1.77%
Chinese, English and Japanese (or in reverse order)	3	1.33%
Italian	3	1.33%
Danish	3	1.33%
Total	226	100.00%

2) Language code selection. In multilingual societies, the types of languages on language signs and the sequential order of languages on multilingual signs are often governed by language policy and planning, and are by no means arbitrary choices. Therefore, the relative importance of languages can be judged by the order and size (i.e. prominence) of language presentation. In examining code orientation on signage it was stipulated that if the codes are arranged vertically, the priority code is to the right of the secondary code. If the code is arranged horizontally, the priority code is above the secondary code. The first language usage of bilingual and multilingual signage is shown in Table 3, and the prominence of bilingual and multilingual usage is shown in Table 4. From the statistics in Tables 3 and 4, Chinese, as the first sequential language, accounts for more than half (63.19%) of the cultural images on A Street, and the strong position of Chinese can also be seen in the linguistic signage on A Street that contains political significance and ideology. In the wave of globalization, strong languages are bound to spread and proliferate internationally, especially English, which is a recognized universal language in the world. Translanguaging practice in urban culture can provide physical evidence of the globalization of English, which is used in 76.99% of linguistic signage. However, most of the billboards have the brand name written in English only and the main information related to the product is still provided in Chinese. As in the case of urban cultures in translanguaging practice, English is mainly symbolic and Chinese is mainly ideological, and Chinese still has a higher actual status than English.

Table 3. First language usage of bilingual and multilingual signage

First language order	Quantity	Proportion
Chinese language	91	63.19%
English	53	36.81%
Total	144	100.00%

Table 4. Prominence of bilingualism and multilingualism

The relative dimensions of language use	Quantity	Proportion
All the same	14	9.72%
Chinese is relatively larger	86	59.72%
Foreign languages are relatively larger	44	30.56%
Total	144	100.00%

3.1.2. **Named Entity Recognition Model Validation Analysis.** The above adopts statistical analysis to systematically describe the application of urban cultural image in translanguaging, reveals the usability of translanguaging practice in the construction of urban cultural image, and lays the theoretical foundation for the construction of knowledge map oriented to urban cultural image.

1) **Experimental Environment.** The PC configuration used for the experiment is Intel(R) Xeon(R) CPU E5-2678 v3 @ 2.50GHz processor, 32G running memory, Ge Force GTX 1080 Ti graphics card, Ubuntu 18.04 LTS system, Python4.5 environment.

2) **Data set information.** In this study, two datasets (A and B) of urban cultural image entity recognition in translanguaging practice are used to comprehensively evaluate the performance of the proposed named entity recognition model. In order to ensure the reliability of the experiments and the superiority of the results, the two datasets were preprocessed in this study, including steps such as data cleaning, word splitting, data labeling, and segmentation of sentence lengths according to the data features and model requirements.

3) **Evaluation Metrics.** When evaluating the performance of the NER model, the main focus is on whether the model can accurately define the boundaries of the entities and classify them correctly. The evaluation of the overall comprehensive performance of the model usually relies on three core indicators: accuracy, recall, and F1 value.

4) **Validation Results.** In order to investigate the recognition effect of BERT-PGD-BiLSTM-CRF in this paper, ablation experiments are conducted in the above datasets, and the results of the ablation experiments are shown in Fig. 1, in which BERT is the baseline model, and (a)~(b) are the datasets A and B, respectively. It can be clearly seen that, in the dataset A, the baseline model is introduced into the PGD, BiLSTM, and CRF in turn, and the results are found to be the three index values of accuracy, recall, and F1 value are significantly improved, and on dataset B, there also exists the type of situation, the recognition model in this paper has excellent performance performance, which greatly ensures the precision of the results of the subsequent research.

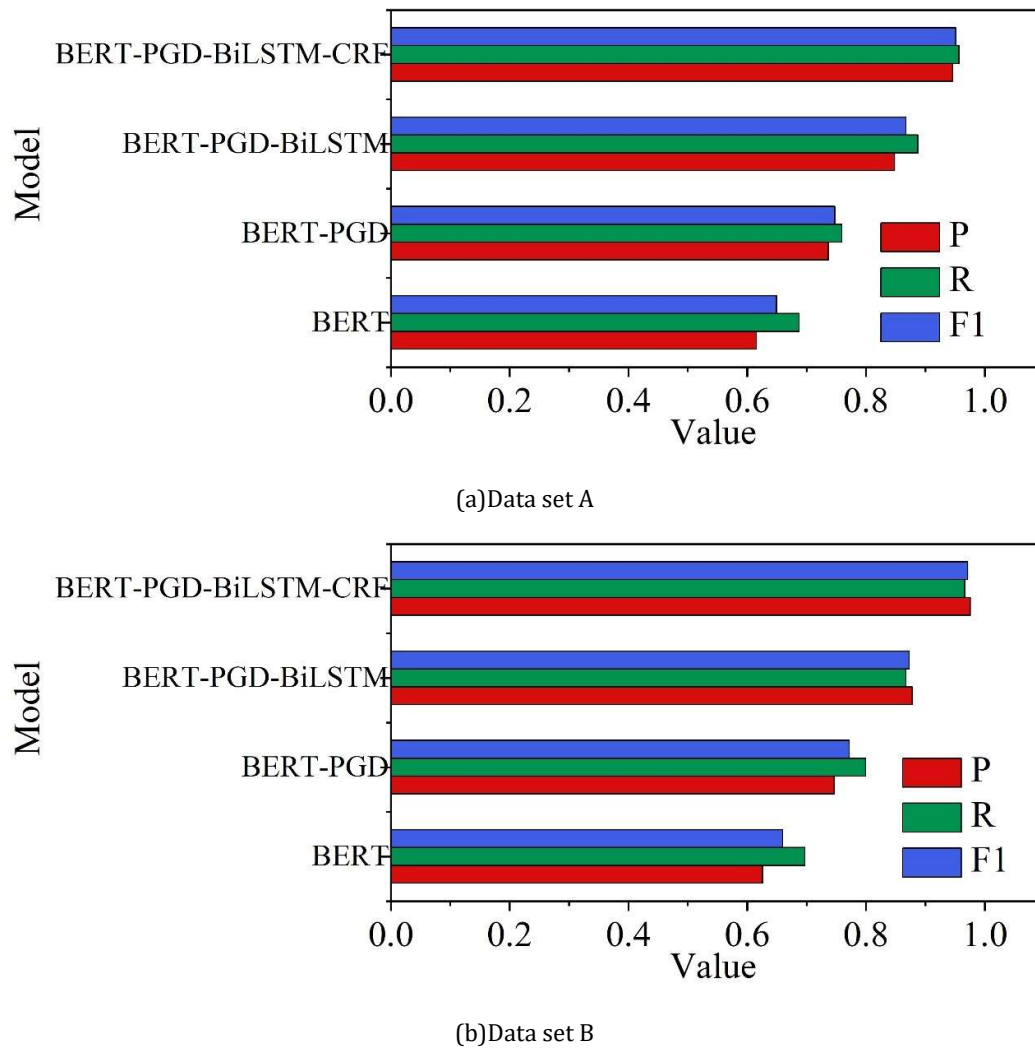


Fig. 1. Analytical results of ablation experiments

3.1.3. Entity Link Analysis Fusing Attributes and Semantic Features. Like the evaluation criteria for named entity recognition, the entity linking task also uses precision, recall and F1 value to evaluate the performance of the links, which will not be repeated here. In this subsection, data C, D, and E are added to the original dataset, and the statistical characteristics of the datasets are shown in Table 5. The data shows that the five datasets A and B datasets have the best performance.

Table 5. Statistical characteristics of data set

Data set	Number of documents	Physical reference quantity	Physical reference quantity /Number of documents
A	923	18479	20.02
B	208	4786	23.01
C	226	4478	19.81
D	45	719	15.98
E	28	249	8.89

Adopting the same method as above, the entity links fusing attributes and semantic features are analyzed by the ablation experiment, and the results of the ablation experiment analysis are shown in Fig. 2, also using BERT as the benchmark model, (a) ~ (c) are the precision, recall and F1 value, respectively. It can be seen that, no matter in which dataset, the performance of this paper's model on entity links fusing attributes and semantic features is particularly outstanding, which indicates that on the benchmark model BERT, the introduction of CBOW and CLS at the same time further enhances the model's generalization ability for entity disambiguation, improves the model's processing effect in

Figure 4 consists of three bar charts labeled (a)P, (b)R, and (c)F1, showing the performance of three models (BERT+CBOW+CLS, BERT+CBOW, and BERT) across five data sets (A, B, C, D, E). The y-axis for all charts ranges from 0.0 to 1.0. The legend for all charts is: BERT+CBOW+CLS (blue), BERT+CBOW (green), and BERT (red).

(a) Precision (P):

Data set	BERT+CBOW+CLS	BERT+CBOW	BERT
A	0.98	0.88	0.76
B	0.92	0.88	0.74
C	0.90	0.88	0.72
D	0.98	0.84	0.76
E	0.98	0.80	0.79

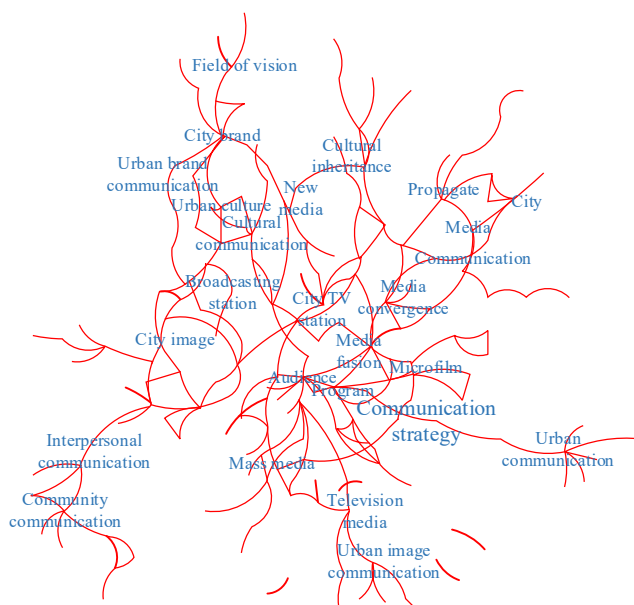
(b) Recall (R):

Data set	BERT+CBOW+CLS	BERT+CBOW	BERT
A	0.95	0.86	0.73
B	0.91	0.84	0.74
C	0.90	0.81	0.70
D	0.90	0.82	0.74
E	0.96	0.87	0.78

(c) F1 score:

Data set	BERT+CBOW+CLS	BERT+CBOW	BERT
A	0.92	0.81	0.73
B	0.90	0.83	0.71
C	0.98	0.80	0.78
D	0.96	0.85	0.75
E	0.98	0.83	0.71

3.1.4. Knowledge graph presentation analysis. Under the guidance of Translanguaging theory, the above model is used to construct a knowledge map oriented to the city's cultural image, and a network analysis diagram is used to describe the knowledge map of this paper, and the knowledge map is shown in Figure 3. It can be clearly seen that the knowledge map consists of 26 keywords, which are composed of keywords such as city image, city culture, cultural communication, etc., which are not expressed in detail, subject to Fig. 3, to provide a theoretical basis for the subsequent analysis of multilevel symbolic flow.



3.2.1. **Symbol Hierarchy Analysis.** The 26 keywords in the above knowledge map are divided into symbol levels, and the results of symbol level division are shown in Table 6. From Table 6, it can be seen that the frequency of vision is the largest (399), with a centrality of 0.6656, which belongs to the

spiritual symbol layer. Spiritual symbol layer contains vision, city culture, city image, communication strategy, social behavior symbol layer contains city brand communication, interpersonal communication, community communication, city image communication, media fusion, city communication, cultural communication, media fusion, communication, communication, material symbol layer contains city brand, mass media, audience, radio station, new media, city TV station, program, TV media, city, Microfilm, Media.

Table 6. Symbol hierarchy partition results

N	Keywords	Frequency	Centrality	Partition result
1	Field of vision	399	0.6656	Mental symbol layer
2	City brand	396	0.6587	Material symbol layer
3	Urban brand communication	379	0.6554	Social behavior symbols
4	Urban culture	361	0.6503	Mental symbol layer
5	City image	360	0.6398	Mental symbol layer
6	Interpersonal communication	351	0.6277	Social behavior symbols
7	Community communication	347	0.5908	Social behavior symbols
8	Mass media	334	0.5727	Material symbol layer
9	Audience	279	0.5658	Material symbol layer
10	Urban image communication	276	0.5402	Social behavior symbol
11	Media convergence	250	0.4946	Social behavior symbol
12	Urban communication	231	0.4924	Social behavior symbol
13	Broadcasting station	226	0.3854	Material symbol layer
14	Cultural inheritance	225	0.2957	Social behavior symbol
15	New media	183	0.2847	Material symbol layer
16	Cultural communication	174	0.2703	Social behavior symbol
17	City TV station	166	0.2686	Material symbol layer
18	Media fusion	138	0.2584	Social behavior symbol
19	Program	132	0.2393	Material symbol layer
20	Communication strategy	104	0.2129	Mental symbol layer
21	Television media	97	0.1901	Material symbol layer
22	City	76	0.1376	Material symbol layer
23	Micro film	30	0.1075	Material symbol layer
24	Propagate	24	0.0674	Social behavior symbol
25	Media	9	0.0633	Material symbol layer
26	Communication	9	0.0498	Social behavior symbol

3.2.2. Symbol dissemination path analysis. The above symbolic hierarchy of the keywords of the Knowledge Graph is divided to understand the distribution of multi-level symbolic flow characteristics, and in order to further enhance the international influence of multi-level symbols in translanguaging practice, the path of symbolic communication is analyzed, and “the more national, the more worldly”. In the multilevel symbolic flow in translanguaging practice, localization of content, localization of media, localization of operation, localization of talents, etc. are the conventional means of localization of symbolic communication. Localization can make communication more grounded: content localization, that is, through the ability to innovate, connecting with modern life production content, using localized social media for communication, finding media suitable for the local area because local people understand the language habits, customs and culture of the local people, and solving the problems that arise from localization with a localized perspective, which requires local high-quality talents to carry out and implement. Overall based on the characteristics and trends of the changing

environment, the multi-level symbolic elements of translanguaging practice need to be injected more into the communication of localization, and the optimization path needs to be upgraded and adjusted.

1) Deep organic integration of social media platforms. Multi-level symbols in translanguaging practice can quickly enhance the overall influence with the help of integrated media communication, and at the same time, the sound diversified media integration system, the formation of the traffic market of symbol communication. Give the advantageous media all kinds of flow resources to enhance the media's own blood production function. Establish the concept of new media communication, explore the channels for the development of translanguaging practice, and build a multi-level and multi-dimensional translanguaging practice communication mechanism, with official communication as the main force, while encouraging the excellent self-media communication, to enhance the audience's experience of the fusion communication of translanguaging practice symbols in a multi-directional way.

2) Emphasize the interpretation of cultural symbols. Under the guidance of translanguaging theory, in order to enable audiences of different cultural backgrounds to have an in-depth understanding of the city's culture and way of thinking, to correctly interpret urban cultural symbols of special significance or special connotation, and to form collective memory in an abstract manner and convey them to the public, so as to achieve the best dissemination effect, this requires that the disseminator of the information strengthen the interpretation of the meaning of the symbols with specific cultural connotations. For example, from the perspectives of local language, architecture, culture and folklore, ceremonial activities, etc., detailed introductions are made through on-site interpretation by experts, textual explanations, and pop-up interactions, so as to enable the audience to deepen their understanding of the city's culture and to make the city's culture glow with stronger vitality.

3.2.3. Trend analysis of symbol evolution. Borrowing the knowledge map in this paper to explore the multi-level symbol evolution trend from 2004 to 2023, the results of symbol evolution trend analysis are shown in Table 7. It can be seen that the frequency of material symbol layer, spiritual symbol layer, and social behavior symbols has an increase during this 20-year period, but the trend of the growth of social behavior symbols is significantly higher than that of material symbol layer and spiritual symbol layer, and it is in line with the current development trend of society.

Table 7. Analysis of symbol evolution trend

Year	Mental symbol layer	Material symbol layer	Social behavior symbols
2004	12	44	55
2005	15	53	83
2006	116	98	88
2007	177	124	89
2008	202	138	97
2009	205	166	164
2010	222	169	176
2011	238	183	265
2012	241	188	283
2013	241	198	399
2014	275	220	405
2015	277	334	459
2016	287	339	463
2017	321	393	465
2018	329	395	502
2019	334	401	517

2020	353	412	525
2021	387	413	546
2022	390	454	559
2023	391	468	565

4. Conclusion

This paper constructs a knowledge map oriented to the city's cultural image with the support of knowledge map and translanguaging theory, and explores the multi-level symbolic flow with the help of this paper's knowledge map.

1) Among all single-language usage, English is found to have the highest proportion, with a figure of 22.57%, which performs better compared to other languages, in addition to Chinese as the mainstream language of the city's cultural image, with a proportion of 63.19%. As far as the construction of the city's cultural image in translanguaging practice is concerned, English is the main symbol and Chinese is the main ideogram, and the actual status of Chinese is much higher than that of English in that city. Finally, the recognition model and the entity linking method of fusing attributes and semantic features in this paper have excellent performance, which ensures that the constructed knowledge graph meets the research requirements.

2) The 26 keywords in this paper's knowledge graph are divided into material symbol layer, spiritual symbol layer, and social behavioral symbols, and then the symbol propagation path is proposed and the symbol evolution trend is analyzed. It is found that the trend of social behavior symbols is better than that of material symbol layer and spiritual symbol layer, which matches the current social development trend.

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