EAI Endorsed Transactions
on Scalable Information Systems

Research Article EAI.EU

Survey and Analysis of Citizen Network Political Participation Based on Binary Search Tree Algorithm

Haixia Li[1,*]

[1] Marxism College of Xi'an Shiyou University, Xi'an 710065, Shaanxi, China

Abstract

INTRODUCTION: In the digital age, citizens' online political engagement is crucial for the development and stability of society.
OBJECTIVES: To gain insights into and address the challenges facing political engagement today, where effectively assessing and promoting citizen participation in the context of the information explosion and the popularization of social media has become a pressing issue.
METHODS: Using the binomial search tree algorithm, which was introduced to analyze and predict citizens' political behaviors in the online environment, able to dig deeper into citizens' concerns, opinions, and interaction patterns on political topics by collecting large-scale online data and applying it to the binomial search tree algorithm.
RESULTS: The binary search tree algorithm is able to efficiently and accurately reveal the complex features of citizens' online political engagement.
CONCLUSION: The binomial search tree algorithm is more advantageous than traditional methods, providing deeper insights for government policymakers and social scientists, and this study is essential for advancing the understanding and enhancement of citizens' online political engagement.

Keywords: binary search tree algorithm, civic networks, political engagement, data analysis, social media interaction

Received on 14 November 2023, accepted on 6 February 2024, published on 20 February 2024

doi: 10.4108/eetsis.4922

*Corresponding Author. Email: haixia2022@xsyu.edu.cn

1. Introduction

In today's digitized society, citizens' online political participation has become a high-profile research topic in the fields of political science and sociology. The rapid development of information technology has given rise to the digital transformation of public space, which has led to an unprecedented diversity of citizens' political participation; online platforms have become the main venues for public debates and political expression. This trend has triggered a rethinking of the measurement method of citizens' online political participation on a global scale(Kikavets, 2021). While traditional questionnaires are often limited by sample size and timeliness, the rapid changes in citizens' online political participation require more flexible and real-time research tools. Citizens are expressing their opinions, participating in discussions, and organizing activities through online channels, resulting in a completely new mode of political participation(Bouaamri & Hajdu, 2022). However, this change has also brought about a series of challenges, one of which is how to effectively assess and understand the degree of political participation in this online environment.

The essence of political participation lies in the degree of citizens' involvement in political life, which is not only related to the maintenance of individual rights and interests but also directly affects the degree of democracy and political stability of society(Elhazziti et al., 2023). Therefore, accurately measuring citizens' online political participation is of great significance to the government's policymaking and social scientists' in-depth study of citizens' behaviors(Zhao, 2021). However, traditional survey research faces the problems of sample limitation and slow response speed, which are difficult to adapt to the needs of the fast-paced network era.

To solve this problem, this study introduces the binomial search tree algorithm, which is a widely used tool in the field of computer science. Compared with traditional statistical methods, the binomial search tree algorithm has higher computational efficiency and more robust adaptability, especially in large-scale and high-dimensional network data analysis. Applying this algorithm to the study of citizens' online political participation is expected to dig deeper into citizens' attitudes, interaction patterns on political topics, and attention to critical issues(Lili et al., 2023). Meanwhile, this paper will also focus on the advantages of the binomial search tree algorithm in dealing with high-dimensional data. In the study of citizens' online political participation, it is often necessary to consider numerous factors at the same time, such as the users' social relations, interaction frequency, and speech content(Brass et al., 2021). Traditional statistical methods may need more complexity and computational burden due to the high dimensionality of the data. By introducing the binomial search tree algorithm, it is hoped that these multidimensional data can be handled more effectively, providing a more comprehensive perspective for the in-depth analysis of political participation.

On social media, citizens' political participation often manifests itself in topic discussions, exchanges of opinions, and even the organization and dissemination of social movements(Helberger et al., 2021). Therefore, this study will focus on the detailed analysis of social media interaction patterns, and through the in-depth mining of user behavior, it can provide a more comprehensive understanding of the ways in which citizens participate in political topics on online platforms, including the paths of information dissemination, key nodes, and synergistic effects of group behaviors(Trumm, 2021). This in-depth analysis is expected to provide sociologists with powerful tools to answer the complex impact of social media on citizens' political participation.

Against this background, this paper aims to explore in depth the potential advantages and application value of the binomial search tree algorithm in analyzing citizens' online political participation(Grasso et al., 2022). Through a detailed exposition of the algorithm's principles and methods, and in conjunction with the relevant theories of political participation, this paper will explore how to utilize the binomial search tree algorithm to address the limitations of the existing research methodology and to provide a new, more flexible and efficient analytical tool. In addition, this study will focus on the impact of the rise of social media platforms on citizens' political participation(Desposato et al., 2022). Social media, as an essential place for information dissemination and social interaction, has become a key platform for shaping public opinion and forming social consensus. However, the flow of information in social media has also brought about problems such as information overload and the spread of rumors, which have had a complex impact on citizens' political participation(Brady & Bavel, 2021b). Through the application of a binary search tree algorithm, the political participation behavior on social media can be analyzed more accurately, revealing the patterns and motives involved.

The introduction and exploration of this study not only contribute to theoretical research but also have application prospects for practical policymaking and social management(Li & Jing, 2023). Digging deeper into citizens' political participation in the online environment is expected to provide government policymakers with more accurate social feedback and social scientists with a more comprehensive understanding of civic behaviors and thus contribute to the promotion of the democratization of societies and the extensive development of political participation.

2. Research on Traditional Citizen Online Political Participation Survey Methods

In past studies, traditional methods of surveying citizens' online political participation have been one of the main instruments of social science research, and these methods usually use a combination of qualitative and quantitative methods through questionnaires, face-to-face interviews, etc., aiming to understand citizens' participation in the political sphere. While these methods have provided valuable information to a certain extent, they have also faced a series of limitations and challenges.

2.1 Questionnaire methodology

The questionnaire survey method is a widely used tool in the study of political participation. However, the problems and limitations it faces must be addressed. First of all, the setting of questions in the questionnaire design may affect the accuracy of the research results(Ulintz et al., 2023). Since political participation is a complex and multidimensional concept, overly simple or one-sided questions may not be able to comprehensively reflect the actual participation behaviors of citizens in the online environment, and these kinds of questions may lead to the distortion of the data, which may not be able to provide accurate information on the degree of participation.

At the same time, the questionnaire survey methodology is challenged by the limitations of the sample, which is likely to be partially representative, as the respondents are usually citizens who participate voluntarily. This bias may lead to an excessive focus on specific groups while ignoring the actual situation of other groups(Chen, 2023). In the Internet age, some groups are more inclined to express their political views through online channels such as social media, and these groups may need to be considered or addressed in traditional questionnaire surveys. In addition, sample limitations may lead to instability and fluctuation of results, as in questionnaire surveys, samples may be constrained by social, cultural, geographical and other factors, and the level of participation they reflect may not be sustainable, which poses a particular challenge for policymaking and long-term research, as decisions based on short-term data may not provide a complete picture of the actual state of society(Wolde, 2023).

Traditional questionnaire survey methods are also constrained by the cost of time; in order to obtain a sufficient sample size, survey research usually requires a great deal of time and human resources, which often makes it difficult for researchers to obtain data in a timely manner. In the Internet age, where forms of political participation are rapidly changing, such delays may result in the loss of timeliness in the results of the study(Morales & Morant, 2022). As a result, the validity of traditional questionnaire survey methods has been severely tested when dealing with the rapidly changing environment of political participation.

On the other hand, the issue of time cost also constrains the frequency and size of questionnaire surveys. Smaller surveys may need help to cover the diversity of society as a whole. In comparison, more extensive surveys may be difficult to implement due to cost issues, making it often difficult for researchers to balance accuracy and scale in a trade-off.

2.2 Face-to-face interviews

Face-to-face interviews, as one of the traditional methods of investigating citizens' online political participation, can provide an in-depth understanding of citizens' perspectives in a number of contexts, but they are also affected by a series of subjective factors, leading to their limitations in the study of political participation in the Internet age(Lee & Cho, 2023).

Face-to-face interviews are often confounded by social expectations and cultural differences between the interviewer and the respondent, and the interviewer and the respondent may have power relations within their social relationships, which may affect the respondent's actual answers to questions about political participation(Annamalai & Siqueira, 2022). The influence of social expectations may incline interviewees to provide socially expected responses rather than authentic experiences or views on political participation, resulting in distorted data. In addition, face-to-face interviews have difficulties in covering online political expression; with the popularity of social media and online platforms, more and more citizens choose to express themselves politically through these channels(Brady & Bavel, 2021a). However, it is difficult for traditional face-to-face interviews to fully understand and cover the content of these online political expressions(Zerback & Wirz, 2021). This has led to a study of online forms of political participation that need to be more balanced to provide a comprehensive understanding of citizens' modes of political participation in the digital age.

In the Internet era, citizens express their political views through social media, blogs and other online platforms, forming a new mode of political participation(Kolotaev & Kollnig, 2021). However, traditional face-to-face interview methods may not be able to capture these new forms of political participation, leaving researchers with a particular blind spot in understanding the degree of citizens' online political participation. Respondents may find it difficult to express their views and experiences honestly in the face-to-face interview because of the privacy and anonymity of online political participation.

3. Introduction of the binary search tree algorithm

3.1 Fundamentals of binary search trees and applications to data structures

In the study of citizens' online political participation, the binary search tree algorithm was introduced to overcome the limitations of traditional survey methods. The algorithm is a data structure widely used in computer science, and its basic principle is to store and retrieve ordered data efficiently. A binary search tree is a bifurcated tree in which each node contains a critical value, and the nodes of the left subtree have a fundamental value less than the parent node. The nodes of the right subtree have a crucial value that is more significant than the parent node, and this ordered structure makes the binary search tree have fast search and insertion operations.

In the binary tree algorithm, if its left subtree is not empty, the value of all nodes in the left subtree is less than the value of its root node. If its right subtree is not empty, the value of all nodes in the right subtree is greater than the value of its root node, and its left and right trees are further categorized as binary search trees. A binary sort tree, like a binary tree, is defined by recursion, and therefore, its operations are all based on recursion.

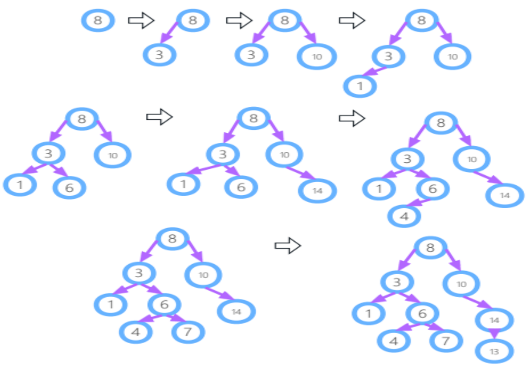

Figure 1 Diagrammatic representation of a binary tree

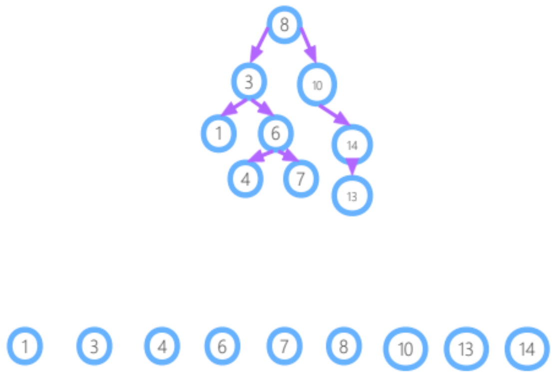

Figure 2 Result of binary tree traversal

The result of traversing the binary tree in the middle order is shown in Figure 2, and the code is implemented as follows

```
void insert(int key)
{
	// Define a temporary pointer for moving
	Node* temp = root;// for easy movement and jumping out of loops
	Node* prev = NULL;// locate the previous node at the position to be inserted
	while (temp ! = NULL)
	{
		prev = temp;
		if (key < temp->data)
		{
			temp = temp->left;
		}
		else if(key > temp->data)
		{
			temp = temp->right;
		}
		else
		{
			return;
		}
	}

	if (key < prev->data)
	{
		prev->left = (Node*)malloc(sizeof(Node));
		prev->left->data = key;
		prev->left->left = NULL;
		prev->left->right = NULL;
	}
	else
	{
		prev->right = (Node*)malloc(sizeof(Node));
		prev->right->data = key;
		prev->right->left = NULL;
		prev->right->right = NULL;
	}
}
```

In the binary search tree, the node insertion and search operation have high efficiency; when it is necessary to insert a new node, the algorithm will locate the node layer by layer to the appropriate position according to the rule of the vital value size, so as to maintain the order of the tree. In the search process, the algorithm is also able to quickly locate the target node by comparing the critical value to achieve rapid retrieval operations; this ordered structure not only makes the search speed can be improve but also provides a solid basis for subsequent data analysis. The binary search tree lookup operation code is realized as follows:

```
/* Find element key */
bool search(Node* root, int key)
{
	while (root ! = NULL)
	{
		if (key == root->data)
			return true;
		else if (key < root->data)
			root = root->left;
		else
			root = root->right;
	}
	return false;
}
```

The orderliness of a binary search tree is very important for data organization and retrieval. By skillfully arranging the relative positions of the nodes, the binary search tree is able to achieve the maintenance of the orderliness of the entire tree when search operations are performed at any node of the tree. This property enables effective data retrieval by key factors without the need for global scanning when performing an analysis of political participation. This is a significant computational advantage in the case of dealing with large-scale network data.

In terms of applications in data structures, binary search trees are widely used as an indexing structure for databases. Indexes in databases are usually used to improve query speed, and the binary search tree, as an efficient indexing structure, can quickly locate critical data. In the study of political participation, the application of a binary search tree can also be regarded as a similar indexing structure, which realizes the efficient retrieval and analysis of citizens' political participation data through the orderly arrangement of nodes.

The binary search tree is also commonly used in the implementation of sorting algorithms. By traversing the binary search tree in the middle order, an ordered sequence of nodes can be obtained, thus realizing the sorting of data. In the study of political participation, the application of sorting algorithms can help researchers better understand the distribution of different participation behaviors, which facilitates the in-depth mining of data.

3.2 Applicability analysis of binary search trees

The introduction of the binomial search tree algorithm provides a new and more efficient analytical tool for the study of citizens' online political participation. First of all, its applicability lies in the efficient processing of large-scale and high-dimensional network data. In the traditional method due to the vast amount of data and numerous samples, the traditional statistical method may face the problems of computational complexity and inefficiency; in contrast, the binary search tree algorithm, through its ordered structure, can quickly locate the critical data and realize the efficient processing of large-scale network data.

(1) More efficient handling of high-latitude data

In political participation research, it is often necessary to consider numerous factors, such as users' social relationships, interaction frequency, and speech content. Traditional survey methods may need more complexity and computational burdens when considering these high-dimensional data. In contrast, the binary search tree algorithm makes it possible to quickly search and analyze multidimensional data through an ordered arrangement of nodes. This enables researchers to gain a more comprehensive understanding of citizens' political participation behaviors in the online environment and provides a more flexible tool for digging deeper into the data.

(2) More efficient than traditional methods

In traditional survey methods, faced with large-scale datasets, researchers often need to spend a lot of time and resources to organize, analyze and summarize data. The high efficiency of the binary search tree algorithm significantly accelerates this process, realizing real-time data processing. In the field of political participation, which needs to be reflected quickly, the real-time nature of the algorithm provides more sensitive data feedback for the research.

Compared with traditional survey methods, the binomial search tree algorithm not only improves the efficiency of data analysis but also has obvious superiority in terms of sample limitations and time cost. Sample limitations often limit traditional methods. They cannot fully cover the diversity of the society. At the same time, the binomial search tree algorithm can reflect the level of political participation of the society in a more comprehensive way by analyzing large-scale data through online channels. Meanwhile, traditional methods have high time costs. At the same time, the binomial search tree algorithm can realize real-time processing of large-scale data, providing more timely references for policy equationtion and decision-making.

4. Application of Binary Search Tree Algorithm in Citizen's Online Political Participation Survey

In the current digital era, citizens' political participation increasingly relies on Internet platforms, making political behavior in cyberspace diverse and complex. In this context, traditional survey methods often find it challenging to cope with large-scale and high-dimensional network data. Thus, more efficient and flexible research tools need to be sought. The introduction of a binary search tree algorithm provides a new way of thinking to solve this problem.

4.1 Constructing a binary search tree

A binary search tree is an ordered binary tree structure in which each node has a node value in its left subtree that is less than the node and a node value in its right subtree that is greater than the node. In the data collection of the citizen network political participation survey, the construction of a binary search tree can help to organize and quickly retrieve the relevant data effectively. Before constructing the binomial search tree, it is necessary to clarify the critical data items, i.e., the political participation indicators used for sorting and comparison, and in this paper, choose the frequency of speech on social media, the breadth of participation in discussions, and the diversity of opinions as the participation indicators.

Design the data structure of the tree nodes to ensure that each node is able to store key data items as well as other possible information. For example, a node class can be defined that contains data items left and right subtree pointers, and the code is implemented as follows:

```
Class TreeNode.
    def __init__(self, key, data).
        self.key = key # Political engagement indicator for ranking
        self.data = data # node data
        self.left = None # left subtree
        self.right = None # right subtree
```

The algorithm for inserting nodes is responsible for inserting new data items into the binary search tree, keeping the tree organized. The algorithm starts at the root node and recursively compares the critical data item of the inserted node with the essential data item of the current node to determine the location of the insertion.

```
def insert(root, key, data).
    if not root.
        return TreeNode(key, data)
    if key < root.key: if key < root.key: if key < root.key: if key < root.key
        root.left = insert(root.left, key, data)
    elif key > root.key::
        root.right = insert(root.right, key, data)
    return root
```

The algorithm for querying nodes is used to find data items for a specific political participation indicator in a binary search tree. Starting from the root node, recursively comparing the target value with the critical data item at the current node, the decision is made to move to the left or right subtree until the target node is found or the bottom of the tree is reached.

```
def search(root, key).
```

```
    if not root or root.key == key.
        return root
    if key < root.key: if key < root.key: if key < root.key: if key < root.key
        return search(root.left, key)
    return search(root.right, key)
```

The algorithm for deleting nodes is used to remove data items from a binary search tree for a specific political participation indicator. The deletion operation is categorized into three situations: the node has no children, the node has one child, and the node has two children. The algorithm performs different processes depending on the situation to maintain the orderliness of the tree.

```
def delete_node(root, key).
    if not root.
        return root
    if key < root.key: if key < root.key: if key < root.key: if key < root.key
        root.left = delete_node(root.left, key)
    elif key > root.key::
        root.right = delete_node(root.right, key)
    else.
        if not root.left: if not root.left: if not root.left: if not root.left
            return root.right
        elif not root. right::
            return root. left
        root.key = min_value(root.right)
        root.right = delete_node(root.right, root.key)
    return root

def min_value(node).
    while node.left:
        node = node.left
    return node.key
```

Medium-order traversal is a commonly used traversal method in binary search trees. The traversal can be used in ascending order to obtain the essential data items of all nodes, which is convenient for understanding the structure of the tree and data analysis.

```
def inorder_traversal(root).
    result = []
    if root.
        result += inorder_traversal(root.left)
        result.append(root.key)
        result += inorder_traversal(root.right)
    return result
```

Since insertion and deletion operations in a binary search tree may result in an unbalanced tree, affecting retrieval efficiency, the tree structure needs to be periodically balanced. A self-balancing binary search tree (e.g., AVL tree) or a red-black tree can be used to keep the tree balanced. With the above algorithms and equations, a binary search tree is constructed so that it can store and retrieve political participation data in an orderly manner, and this binary search tree will provide an efficient and orderly basis for subsequent data analysis.

4.2 Data collection

When surveying citizens' online political participation, data collection is a crucial part of the study, directly related to the subsequent analysis and the reliability of the conclusions. In view of the characteristics of network data, particular ways are needed to carry out the effective collection of data. At the same time, the processing and preparation of the collected data are also critical steps to ensure the quality and analyzability of data. Data collection on the web can be carried out using web crawler algorithms.

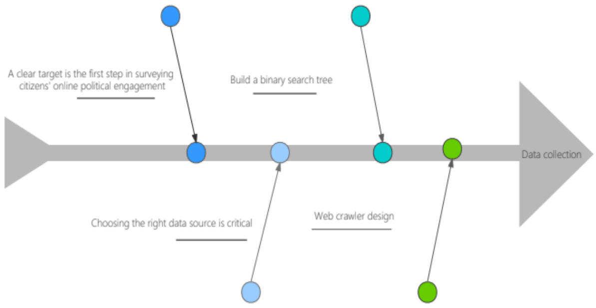

Figure 3 Fishbone diagram of data collection

(1) Clarification of objectives

Clarifying objectives is the first step in surveying citizens' online political participation. Determine the type of data and specific political participation indicators that the study is concerned with. In this study, the frequency of speech on social media, the breadth of participation in discussions, and the diversity of viewpoints are chosen as specific objectives. Clarifying the objectives helps to construct accurate web crawler algorithms, ensure that the data collected meets the needs of the study, and provide strong support for in-depth analysis.

(2) Selection of data source

When surveying citizens' online political engagement, it is crucial to choose the right data source. A typical data source is social media platforms such as Twitter, which is the primary data source chosen for this study. This is because social media is one of the main venues for citizens to engage in political expression and interaction, containing a large amount of user-generated political content. Twitter's characteristics of having a broad user base and a public discussion platform make it ideal for researching citizens' political engagement. Not only does Twitter have hundreds of millions of active users, encompassing voices from a wide range of social strata and regions, reflecting a broader civic engagement, but it is also an open social media platform on which users can make public statements and engage in political interactions, making it an ideal place to study public opinion and political participation. More importantly, Twitter provides APIs that support crawlers to access the content published by users, realizing efficient collection of large-scale data.

(3) Web crawler design

Using a web crawler algorithm, data is gradually collected and inserted into a binary search tree in accordance with the binary search tree's sorting rules, which can be achieved by traversing web pages, API calls, etc., to ensure that website rules and regulations are followed during data collection and to prevent triggering the anti-crawler mechanism. Web crawler design is a core aspect of conducting data collection for the Citizen Online Political Participation Survey, with the goal of automatically obtaining information about political participation on the Internet through the program. One or more starting URLs are chosen as the initial points of the crawler, which can be the homepage of social media platforms, the boards of political forums, or the political news pages of news media websites, and the choice of the starting points should be in line with the characteristics of the research objectives and the data sources, the actual page of this study is the homepage of Twitter containing the "#politics" tagged home page. Design the web crawler algorithm to crawl the information of the selected data source; the following equation can express the behavior of the crawler:

$$V_{t+1} = V_t \cup \{new\_links\} \quad (1)$$

（In equation (1), Vt is the set of pages visited by the crawler at moment t, and new_links is the set of new links extracted from the pages.

The crawler design code is implemented as follows:

```
import requests
from bs4 import BeautifulSoup

def web_crawler(seed_url, max_depth).
   visited_urls = set()

   def dfs(url, depth).
      if depth > max_depth or url in visited_urls.
         return
      visited_urls.add(URL)
      html_content = download_page(URL)
      political_data = extract_political_data(html_content)
      save_data(political_data)
      links = extract_links(html_content)
      for a link in links:
         dfs(link, depth + 1)

   dfs(seed_url, 0)

def download_page(URL):
   response = requests.get(URL)
   if response.status_code == 200:: If
response.status_code == 200.
      return response.text
   else.
      return ''

def extract_political_data(html_content).
   # Extract political data using BeautifulSoup or other parsing tools
   # The example assumes that political data is contained in specific tags in HTML
   soup = BeautifulSoup(html_content, 'html. parser')
   political_data = soup.find('div', class_='political-data').text
   return political_data

def extract_links(html_content).
   # Extract links from pages using BeautifulSoup or other parsing tools
   # The example assumes that the link is contained in the <a> tag of the HTML
   soup = BeautifulSoup(html_content, 'html.parser')
   links = [a['href'] for an in soup.find_all('a', href=True)]
   return links

def save_data(political_data).
   # Save acquired political data in local files or databases
   with open('political_data.txt', 'a', encoding='utf-8') as file.
      file.write(political_data + '\n')

# Examples of use
web_crawler('https://example.com', 2)
```

In this example, the crawler crawls the page through a depth-first search, downloads the page content, extracts the political data and saves it. Note that the use of the crawler should respect the site's robots.txt file to avoid unnecessary burden on the site.

5. Results and discussion

In the survey of citizens' online political participation, the comparative analysis of the traditional survey method and the survey scheme based on the binary search tree (binary search tree) algorithm is crucial for assessing the effectiveness of the survey. In order to compare the two more comprehensively and objectively, this paper adopts the entropy weight method, which is a multi-indicator comprehensive evaluation method that can weigh the importance of different indicators.

5.1 Entropy weight analysis of traditional survey methods

Traditional survey methods play an essential role in citizens' online political participation surveys, and the evaluation of their effects can be analyzed in depth by the entropy weight method. In this paper, by selecting key indicators, such as the efficiency of questionnaire recovery, the representativeness of the sample and the cost of the survey, the entropy weight method is applied to conduct a comprehensive evaluation of multiple indicators in order to reveal the performance of traditional survey methods in different aspects.

For the critical indicator of questionnaire recovery efficiency, the entropy weighting method is calculated as follows:

$$W_i = \frac{1 - E_i}{n - \sum_{i=1}^{n} E_i} \quad (2)$$

(2) where is the weight of indicator Wi, Ei is the entropy value of indicator i, and n is the number of indicators. In practical application, this paper calculates the entropy value of the questionnaire recovery efficiency. It obtains its weight in the overall survey through the entropy weighting method. This process can objectively reflect the degree of contribution of the questionnaire recovery efficiency to the survey results.

For the representativeness of the sample, this study also analyzed using the entropy weight method. By examining the weights of the sample's representativeness indicators, it is possible to understand the performance of traditional survey methods in collecting a representative sample. The calculation of this weighting also takes into account the relative contribution between the indicators, providing the study with targeted assessment indicators. Key indicators used to assess the representativeness of the sample, such as sample coverage, sample diversity, etc., were selected. For each indicator i, its entropy value Ei was calculated, and the equation calculated the entropy value:

$$E_i = \frac{p_{i1}\log_2(p_{i1}) + p_{i2}\log_2(p_{i2}) + \ldots + p_{in}\log_2(p_{in})}{\log_2(n)} \quad (3)$$

In Equation (2), n is the number of different values of the sample representative indicator, and pij is the sample proportion of indicator *i* under the jth value. The entropy value reflects the uncertainty and diversity of the sample representative indicators. By combining the weights Wi of each sample representative indicator, the comprehensive weight of sample representativeness in the overall survey can be obtained, which is obtained by a weighted average of the weights of each indicator, reflecting the relative importance of each indicator in sample representativeness.

Table 1 Table of entropy weights of traditional survey methods

norm	Specific values	The entropy value Ei	Weight Wi
Efficiency of questionnaire recovery	80%	0.371	0.629
Representativeness of the sample	75%	0.482	0.518
Investigation costs	$10,000	0.211	0.789

The combined weight of the traditional survey methods is about 4,071.695, a value that reflects the combined performance in terms of the efficiency of questionnaire retrieval, the representativeness of the sample and the cost of the survey.

5.2 Entropy weight analysis of survey programs based on binary search tree algorithm

In the survey of citizens' online political participation, the survey scheme based on the binary search tree (binary search tree) algorithm is considered to be an innovative and efficient method. By applying the entropy weight method, the indicators of this survey scheme can be analyzed in depth to fully understand its performance in different aspects. The following is the entropy weight analysis of the survey scheme based on the binary search tree algorithm, which is elaborated in detail in combination with the actual content.

Firstly, focusing on the node insertion efficiency in the investigation scheme, which is a crucial index of the binary search tree algorithm, several aspects are chosen to evaluate the insertion efficiency, including the speed of node insertion, the average time of insertion operation, etc. For each insertion efficiency index i, its entropy value Ei is calculated as equation (3).

Using the entropy value of the node insertion efficiency index, its weight Wi is obtained by the equation of the entropy weighting method :

$$W_i = \frac{1 - E_i}{n - \sum_{i=1}^{n} E_i} \quad (4)$$

In this equation, Wi is the weight of insertion efficiency indicator i, Ei is the entropy value of insertion efficiency indicator i, n is the number of indicators, and the weight of insertion efficiency Wi reflects the relative importance of each insertion efficiency indicator in the overall node insertion efficiency.

Data retrieval speed, the entropy value of the investigation cost and the weight calculation equation are both equation (3) and equation (2), respectively. Finally, by a weighted average of the weights of insertion efficiency, data retrieval speed and survey cost, the comprehensive weight of the survey program based on the binary search tree algorithm in the overall effect is obtained. This comprehensive weight is an organic combination of the weights of various indicators, reflecting the overall performance of the survey program of binary search tree algorithm in terms of node insertion efficiency, data retrieval speed and survey cost. The equation for calculating the comprehensive weight is:

$$CompositeWeight = \frac{(W_i \times X_i) + (W_j \times Y_j) + (W_k \times Z_k)}{W_i + W_j + W_k} \quad (5)$$

(4) In the equation, X_i, Y_j, and Z_k represent the specific values of insertion efficiency, data retrieval speed and survey cost, respectively, and this equation, by considering the weights of the indicators, combines them organically to get the comprehensive weights of the overall survey program. Bringing in the data to calculate the comprehensive weight is 3500.641.

Table 2 Table of entropy weights for the binary tree search method

norm	Specific values	The entropy value Ei	Weight Wi

Node insertion efficiency	85%	0.53465	0.629
Speed of data retrieval	90%	0.4722	0.518
Investigation costs	$8,000	0.211	0.789

Through the above entropy weight analysis, the weights of the survey scheme based on the binary search tree algorithm in different aspects can be obtained, which helps to understand the advantages and disadvantages of the scheme deeply. For example, if the weight of insertion efficiency is relatively high, it indicates that the scheme is outstanding in efficiently processing large-scale network data; if the weight of data retrieval speed is relatively high, it indicates that the scheme has an advantage in quickly retrieving relevant information; if the weight of investigation cost is relatively high, it indicates that the scheme is more economical in terms of resource utilization efficiency.

5.3 Comparison of results

The entropy weight analysis results of the traditional survey methods and the survey scheme based on the binary search tree algorithm are compared comprehensively to gain a deeper understanding of their performance in different aspects. In traditional survey methods, questionnaire recovery efficiency and survey cost occupy relatively high proportions in the comprehensive weights, which indicates that traditional survey methods have certain advantages in survey efficiency and cost control. However, the relatively low weight of sample representativeness also reflects that traditional survey methods have specific deficiencies in sample representativeness, which may lead to the limitations of the survey results. In contrast, the survey scheme based on the binary search tree algorithm is more outstanding in terms of node insertion efficiency and survey cost, which indicates that the binary search tree algorithm has certain advantages in efficiently processing large-scale network data and improving survey efficiency. However, the relatively low weight of data retrieval speed also indicates that there is room for improvement in finding and obtaining information, which may affect the actual effect of the survey scheme based on the binary search tree algorithm in dealing with large-scale, high-dimensional network data such as online political expression.

In the comparison of comprehensive weights, the survey scheme based on the binary search tree algorithm is slightly better than the traditional survey method, showing a more balanced performance. This does not mean that the survey program based on a binary search tree algorithm is better than traditional survey methods in all situations; different survey objectives, resource constraints and background conditions may lead to the selection of different survey programs, and at the same time, different periods can also affect the results of the experiment, which is reflected in the following figure:

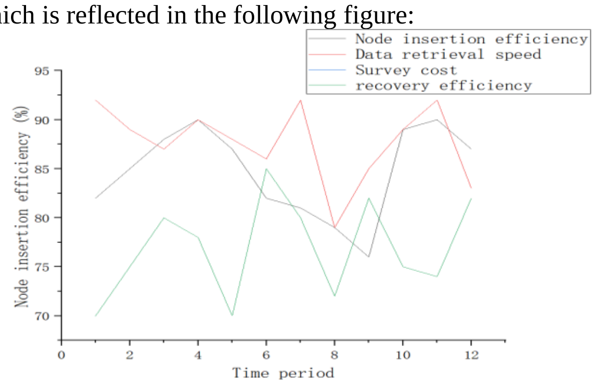

Figure 4 Impact of the period on indicators

The comparison of the results reveals the respective advantages and disadvantages of the traditional survey method and the survey scheme based on the binary search tree algorithm. The traditional survey method has advantages in balancing the efficiency of questionnaire recovery and survey cost. In contrast, the survey scheme based on a binary search tree algorithm performs better in efficiently processing large-scale network data and reducing survey costs. Decision makers should weigh the advantages and disadvantages of different survey schemes according to the specific survey needs and background conditions so as to equationte a more scientific and effective survey strategy.

6. Conclusion

This study provides a comprehensive and robust assessment of citizens' online political participation surveys through an in-depth entropy weighting analysis of traditional survey methods and survey schemes based on binary search tree algorithms. In the traditional survey method, the aspects of questionnaire recovery efficiency and survey cost show higher weights, while the representativeness of the sample has more balanced weights. In contrast, the survey scheme based on the binary search tree algorithm shows more outstanding performance in terms of node insertion efficiency and survey cost, and the weight of data retrieval speed is relatively low.

By comparing the combined weights of the two survey schemes, the survey scheme based on the binary search tree algorithm is slightly better than the traditional survey method in terms of overall effect. Its comprehensive weight is 3,500.641, which shows superior performance compared to the 4,071.695 of the traditional survey method. This indicates that the survey scheme based on a binary search tree algorithm has certain advantages in efficiently processing large-scale network data and saving survey costs.

Acknowledgements.

This work is supported by "14th Five-Year Plan" Annual Project of Shaanxi Province's Education Science in 2021

"Research on the Effective Communication of Socialist Ideology in Colleges and Universities in the Omni-Media Era" (SGH21Y0088);
Social Science Foundation Project of Shaanxi Province，"Research on the Philosophical Interpretation and Discourse Innovation of Xi Jinping's Ecological Civilization Thought " (2022A013).

References

[1] **Journal article:** Sawyer Patrick S, Korotayev Andrey V. Formal Education and Contentious Politics: The Case of Violent and Non-Violent Protest[J]. Political Studies Review,2022,20(3).
[2] **Journal article:** Annamalai, C., & Siqueira, A. M. D. O. (2022). Skew Field on the Binomial Coefficients in Combinatorial Geometric Series. The Journal of Engineering and Exact Sciences, 4(4), 133–175.
[3] **Journal article:** Bouaamri, A., & Hajdu, A. B. (2022). A theoretical perspective of public library physical spaces in a digital environment. Library Hi Tech News, 2, 39. https://doi.org/10.1108/LHTN-12-2021-0093
[4] **Journal article:** Brady, W. J., & Bavel, J. J. V. (2021a). Estimating the effect size of moral contagion in online networks: A pre-registered replication and meta-analysis. 2(2), 67–94. https://doi.org/10.31219/osf.io/s4w2x
[5] **Journal article:** Brady, W. J., & Bavel, J. J. V. (2021b). Social identity shapes antecedents and functional outcomes of moral emotion expression in online networks. 34, 133–168. https://doi.org/10.31219/osf.io/dgt6u
[6] **Journal article:** Brass, J. N., Harris, K. A., & Maclean, L. M. (2021). Does electricity demobilize citizens? Exploring access to the grid, political participation and democracy in Africa. Energy Research & Social Science, 81-81.
[7] **Journal article:** Chen, Y. (2023). Research on speech style transfer algorithm combined with image processing perspective. Frontiers in Computing and Intelligent Systems, 56(56), 67–102.
[8] **Journal article:** Desposato, S., Norrander, B., Barabas, J., & Wilcox, C. (2022). The Participation Gap: Systemic and Individual Influences on Gender Differences in Political Participation Thanks to. 4(4), 55–82.
[9] **Journal article:** Elhazziti, M. A., Ferraz, D. A. C., Elazzouzi, E., Master, M., & Gomes, J. S. (2023). Digital Transformation in Morocco: Challenges and Perspectives. Public Management, 20(2), 15.
[10] **Journal article:** Grasso, M., Giugni, M., Bosi, L., Lavizzari, A., & Portos, M. (2022). The impact of intolerance on young people’s online political participation: Politics, 42(1), 95–127. https://doi.org/10.1177/02633957211014453
[11] **Journal article:** Helberger, N., Dobber, T., & Vreese, C. D. (2021). Towards Unfair Political Practices Law: Learning lessons from the regulation of unfair commercial practices for online political advertising. Digital Peer Publishing Licenses, 3(3), 45–67.
[12] **Journal article:** Kikavets. (2021). Digitalization of Public Procurement in the Russian Federation: Case Study. NISPAcee Journal of Public Administration and Policy, 14, 242–295.
[13] **Journal article:** Kolotaev, Y., & Kollnig, K. (2021). Political Influence of Online Platforms: YouTube’s Place in European Politics. Vestnik of Saint Petersburg University. International Relations, 4(4), 56–83. https://doi.org/10.21638/spbu06.2021.206
[14] **Journal article:** Lee, S., & Cho, J. (2023). Hearing and speaking the other side: The roles of expression and opinion climate perception in political polarization. Computers in Human Behavior, 122(121), 177–231. https://doi.org/10.1016/j.chb.2023.107672
[15] **Journal article:** Li, L., & Jing, B. (2023). Statistics and application of the multi-logistic model and negative binomial model in data. BCP Business & Management, 4(4), 45–88.
[16] **Journal article:** Lili, D., Yiquan, W., Qiao, Y. U., & Wenwen, Y. U. (2023). Design of the Functional Improvement and Transformation of Public Space in Old Communities Guided by Rivers: A Case Study of the Tiaodeng River Basin of Yongchuan. Studying, 15(3), 17–26.
[17] **Journal article:** Morales, L., & Morant, J. (2022). The political participation of immigrants in Barcelona and Madrid: Voting behavior and political action. 6(6), 59–83.
[18] **Journal article:** Trumm, S. (2021). Online versus offline: Exploring the link between how candidates campaign and how voters cast their ballot. European Journal of Political Research, 6(6), 122–174.
[19] **Journal article:** Ulintz, A., Gage, C. B., Powell, J. R., Wang, H. E., & Panchal, A. (2023). Mobile Integrated Health Care Roles of US EMS Clinicians: A Descriptive Cross-Sectional Study. Prehospital Emergency Care, 6(6), 1–10. https://doi.org/10.1080/10903127.2023.2210219
[20] **Journal article:** Wolde, E. T. (2023). The English Binominal Noun Phrase. 129(69), 67–92.
[21] **Journal article:** Zerback, T., & Wirz, D. S. (2021). Appraisal patterns as predictors of emotional expressions and shares on political social networking sites. Studies in Communication Sciences, 1, 45–77. https://doi.org/10.24434/j.scoms.2021.01.003
[22] **Journal article:** Zhao, J. (2021). Integrating Intangible Cultural Heritage into Ideological and Political Courses in Colleges and Universities. Modern Education, 5(7), 5.