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# Evaluation Method of Information Dissemination Efficiency within Professional Virtual Community: Based on Chinese College and University Students

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## Abstract

The professional virtual community is a unique form of network social communication with the development of the Internet and new media technology. It is a network aggregation space formed by the combination of network user groups for some specific reasons. The professional virtual community, which is characterized by virtual social interaction, thematic concentration, free expression and exclusive environment, has become the main medium for Chinese college and university students to interact online. Different from ordinary Internet users, college and university students prefer to communicate with professional virtual communities and are more easily guided by information from virtual communities. Exploring the evaluation method of information dissemination efficiency is helpful in comparing the difficulty of information publishing and receiving among different professional virtual communities, and to formulate reasonable media operation strategies. At the same time, it can also help college and university administrators better understand students' online social behaviors and provide more targeted services. Based on the characteristics of professional virtual community information dissemination, this paper designs an evaluation index system from static and dynamic dimensions. In order to facilitate comparison, a 5-point scale is used to design the evaluation criteria for all indicators. EWM is used to generate objective weights of indicators, and TOPSIS is used to realize comprehensive evaluation and efficiency ranking. Finally, eight professional virtual communities commonly used by Chinese college and university students are used as examples to measure the effectiveness of the evaluation method.

## Keywords

Professional Virtual Community, Information Dissemination, Efficiency

Evaluation, Chinese College and University Students, EWM, TOPSIS

## 1. Introduction

The 51st China Statistical Report on Internet Development conducted by the China Internet Network Information Centre recorded a total of 1.067 billion Chinese Internet users by December 2022. Among them, 20 - 29 years old Internet users account for 14.2% (CNNIC, 2023). College and university students are the main components of this age group of Internet users. As networked channels, fragmented information, and personalized expression have become the norm for communication, college and university students are fully immersed in a participatory, interactive digital culture that permeates every aspect of their lives (Sullivan et al., 2014).

The rise in communication costs caused by "information explosion" and the decrease in trust caused by "long-distance social interaction" promote the emergence and development of a professional virtual community (Deng & Guo, 2021). Professional virtual community (PVC) refers to the active and efficient aggregation channel of network participants with common hobbies, thinking modes and value orientation on network platforms (Tamjidyamcholo et al., 2014). With the natural advantages of privacy and identity, the PVC, which lies in the "middle zone" between public platforms and face-to-face communication, has become an important information collection and dissemination platform for Chinese college and university students (McConnell et al., 2013).

The unique language system, high topic cohesion, natural sense of trust and relatively independent subculture breeding mechanism, on the one hand, provide an effective way to enrich the spiritual life of college and university students, on the other hand, it also creates a difficult to perceive the "trap" of information dissemination (Ye & Liu, 2022). Exploring the law of information dissemination in PVC is conducive to effectively identifying college and university students' online social preferences and behavioral characteristics, thus helping enterprises effectively improve the effect of marketing information push to students (Giddens et al., 2012; Kim et al., 2015). Meanwhile, educational administrators have long begun to consider how to help students use online social media correctly (Smith & Lambert, 2014). Understanding the information dissemination within the PVC can facilitate colleges and universities to understand the social lifestyle of students, and enhance the communication efficiency of schools, teachers and students (Tsang & Tsui, 2017).

As a network aggregation space formed by network users for some specific reasons, PVC has attracted the attention of researchers in recent years (Tamjidyamcholo et al., 2014). The research results and research methods derived from the fields of network sociability, group culture, instant communication, social cognition, etc., have gradually expanded to the field of PVC. Significant research

progress has been made on the basic characteristics of the professional virtual community, the interaction between PVC attributes and user psychological factors, and the emergence and dissemination of PVC information (Chiu et al., 2011; Ren et al., 2012; Tajvidi et al., 2020; Deng & Guo, 2021).

However, from the perspective of PVC management, how to identify and evaluate the fragmented information dissemination efficiency of professional virtual communities has not made significant progress. The general research method to improve information exposure is to find the drivers of marketing message acceptance and dissemination, and then make targeted management recommendations. This paper presents a different perspective, based on the evaluation results of PVC delivery efficiency, to directly analyze and compare the operational differences between different PVCs. This innovative idea helps to the direct and clear discovery of problems in PVC operation, and quickly find the reference PVC.

In view of this, the paper designs an information dissemination efficiency evaluation method for Chinese college and university students based on the carrier and characteristics of information dissemination within PVCs and uses the Entropy Weight Method (EWM) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to realize the formation of index weights and the integrated measurement of comprehensive results. EWM is a typical diversity-based weighting method, which calculates attribute weights based on the diversity of attribute data in alternative scenarios. Compared with the subjective weighting method, EWM is easy to calculate and does not need to consider subjective preferences. The combination of EWM and TOPSISI has the advantages of intuitive geometric meaning, less information loss and flexible operation.

## 2. Characteristics of Information Dissemination within College and University Students' PVC

With the development of Internet socializing, virtual communities have gradually emerged among college and university students and become an important platform environment for the online life of young people (Pan & Lan, 2009). As an evolutionary form of virtual community, PVCs are widely welcomed by young students due to their advantages such as diverse communication methods, concentrated information, private member relationships, and wide topics (Zhi & Zhang, 2022). In the process of using the PVC for social communication, college and university students also need to be constrained by the basic attributes of the PVC, and the difference in the PVC attributes will affect the social motivation of students.

The professionalism of the topic is the first condition for the establishment of PVC. In most cases, the initial thematic design of the PVC determines the upper limit of the PVC size and the potential for future growth. In the absence of professional interaction and knowledge sharing in PVC, the participation of members will be greatly reduced (Wang et al., 2019). Of course, the appearance of too

much irrelevant information reduces the willingness of members to interact, which will also have a negative impact on user satisfaction (Kim et al., 2021). Especially for college and university students, the PVC, which is in line with their preferences and concerns is more likely to stimulate the willingness to collect and share information (Ye & Liu, 2022). Although students have active thinking, accept new things quickly, dare to express and question, and are full of passion and vitality, due to a lack of social work experience and single social channels, the scope of activities is still limited to the college or university. In many cases, PVCs have become the main channel for them to obtain professional information (Kayode et al., 2012).

Unlike traditional virtual communities, one of the characteristics of PVC is that it has obvious exclusivity. The exclusivity does not mean PVC members oppose all forms of external communication, but rather that members who do not share common interests and concerns and unrelated information are unwelcome. In order to achieve the purpose of differentiating like-minded people, PVCs often form unique language systems (Vătămănescu et al., 2018). The specific form may be the frequent use of professional terms in communication or the need to obtain identity authentication when entering the PVC. College and university students accept new things quickly and have strong language learning and useability (Assimakopoulos et al., 2017). Therefore, the PVCs dominated by student users tend to express themselves in more diversified, personalized and liberalized ways. Non-PVC users have great difficulty understanding these personalized languages, thus strengthening the boundaries inside and outside of PVC.

As a form of social networking, the virtual level of PVC also affects the degree of trust and willingness to communicate between members. But the key between the level of virtuality and members' willingness to share is complex. On the positive side, the higher the virtual level, the more relaxed the communication atmosphere, and the more willing users are to share their knowledge and opinions (Kang et al., 2019). For the above reasons, online communities have become dynamic and vital in developing and maintaining social relationships among strangers in the virtual world (Trehan & Sharma, 2020). However, uncertainty in the online environment can also cause users to hesitate to engage in interactions because the rewards of communication are not clear and there are no material rewards (Chiu et al., 2011). Comparatively speaking, the activity space and social objects of college and university students are more concentrated. The fact that the physical and online worlds cannot be completely separated forces students to constantly assess the reliability of the social environment (Yu & Leung, 2023). Appropriate levels of member information disclosure can have a positive impact on enhancing trust and familiarity (Smith & Lambert, 2014). This is also one of the obvious differences in the mentality of students and other adult user groups when using PVC.

In summary, the key features of information dissemination in PVC are professionalism, exclusivity and virtuality. In terms of influencing online social be-

havior, PVC attracts users by virtue of professional knowledge or goals and relies on exclusivity and virtuality to ensure the security of the communication environment, thus continuously improving user stickiness. For college and university students, the operation model of PVC can effectively reduce the sense of distrust among users, and a wide variety of topics ensure that students can seek help from PVC in all aspects of study and life.

## 3. Construction of Evaluation Index System for Information Dissemination Efficiency

### 3.1. Index System Design

PVCs with higher levels of professionalism, exclusivity and virtuality are more in line with the purpose of online social communication of young users and can build a more comfortable social environment, thus having better social circle group effects (Zhi & Zhang, 2022). This kind of feature belongs to the normal attribute of PVC and can be analyzed as a static index.

The professionalism reflects that the PVC takes the internal common preference as the starting point of construction. It can be measured by topic concentration and opinion leader intensity (Sankaran & Demangeot, 2017; Lopez et al., 2022).

Exclusivity is the main characteristic of the PVCs (Tamjidyamcholo et al., 2014), and a more common phenomenon is that PVC measures its level of exclusivity by the difficulty of access, the uniqueness of the discourse system and the freedom of viewpoint expression.

Virtuality is the main contextual feature of PVC user communication (Vătămănescu et al., 2018). For PVC, the level of virtuality represents the likelihood that users will be familiar with each other's identities. In the social process of college and university students, clear identity information helps students to identify with each other and enhance their willingness to communicate (Yu & Leung, 2023). Considering the impact of environmental privacy and user privacy decisions on information dissemination intentions (Jozani et al., 2020; Alemany et al., 2021), identity information transparency and the offline communication possibility, can be used as a standard to measure the level of virtuality for PVCs.

A willingness to share information and engage in passionate discussions around specific topics are common behaviors among PVC members (Qutab et al., 2022). For college and university users, the speed of production and dissemination of new ideas and new information has attracted widespread attention (Florenthal, 2015). The speed of information production and dissemination can be regarded as important indicators to measure the efficiency of PVC information dissemination (Lai et al., 2014). In contrast to the previous static indexes, such indicators can be called dynamic indexes.

In terms of new information production speed, the speed of information updates in a specific time period can reflect the activity and innovation ability of PVC information release (Tamjidyamcholo et al., 2014). The display time of new

content on the home page or recommendation interface is often considered to be inversely proportional to the speed of information innovation.

In terms of new information dissemination speed, whether one is willing to share one's knowledge and opinions quickly is an important basis for judging the activity of PVC (Chen, 2007). The short-term attention level of the initial release has become the main concern data of various network social platforms, which can be a good indication of the appeal of new information to users. Actions such as liking, commenting, and sharing are common behaviors in which members recognize the value of information and promote dissemination (Kayode et al., 2012). As a means of promotion to improve information exposure, network channel operators or managers often place information, views and content with communication potential at the top or promote them in prominent positions on the interface (Hadija et al., 2012). The more such internal recommendation behaviors, the stronger the information mobility tends to be (Hung et al., 2015).

For college and university students, appropriate marketing campaigns help spread the message among users (Assimakopoulos et al., 2017). In addition, the fragmented information in PVC is often improved or optimized after the initial dissemination due to its simple and easy-to-express content (Tamjidyamcholo et al., 2016). The velocity of such similar new viewpoint derivation can also be used as an important indicator to measure the efficiency of users in disseminating information. The evaluation index system of information dissemination efficiency within PVC is shown in **Table 1**. The sub-indexes will rely on evaluators to assign values and calculate weights with EWM.

According to the static and dynamic characteristics of PVC information dissemination, the specific meaning of each index is explained. As shown in **Table 2**. These explanations cover the consideration of PVC information dissemination environment, frequency, relative level, difficulty, personalization and so on.

**Table 1.** The evaluation index system of information dissemination efficiency.

| Basic category | Primary index | Sub-index |
|---|---|---|
| Static index (SI) | Professionalism (PRO) | Topic concentration (TC) |
| | | Opinion leader intensity (OLI) |
| | Exclusivity (EXC) | Access difficulty (AD) |
| | | Uniqueness of discourse system (UDS) |
| | | Freedom of viewpoint expression (FVE) |
| | Virtuality (VIR) | Identity information transparency (IIT) |
| | | Offline communication possibility (OCP) |
| Dynamic index (DI) | New information production speed (NPS) | New content release intensity (NCRI) |
| | | New content display level (NCDL) |
| | New information dissemination speed (NIDS) | Short-term attention level (STAL) |
| | | Internal recommendation strength (IRS) |
| | | Velocity of viewpoint derivation (VVD) |

Table 2. Index meanings.

| Sub-index | Meaning |
|---|---|
| Topic concentration (TC) | Frequency of occurrence of irrelevant topics |
| Opinion leader intensity (OLI) | The level of influence of opinion leaders |
| Access difficulty (AD) | The difficulty of absorbing PVC |
| Uniqueness of discourse system (UDS) | The difficulty for non-PVC members to understand the discourse system |
| Freedom of viewpoint expression (FVE) | The extent to which opinions are restricted in the circle group |
| Identity information transparency (IIT) | Degree of filing and disclosure of personal information |
| Offline communication possibility (OCP) | Offline communication probability of PVC users |
| New content release intensity (NCRI) | Compared with similar PVC, 24 hours of new information update speed |
| New content display level (NCDL) | Duration of new content on the home page or recommendation screen |
| Short-term attention level (STAL) | 24 hours of new information reading, likes, comments |
| Internal recommendation strength (IRS) | PVC internal new information top or significantly recommended number |
| Velocity of viewpoint derivation (VVD) | Number of relevant new ideas generated in 24 hours |

### 3.2. Index Assignment Method

In order to balance the calculation criteria, the index assignment method based on the five-point system is designed. The evaluators scored the sub-indexes according to the scoring criteria in Table 3 and their own experience. In this process, the scores and semantic criteria of TC and NCDL are negatively distributed. The scores of other indexes and the changes in decision semantics are consistent.

As shown in Table 3, the five-point system based on the evaluator's judgment reduces the complexity of weight determination and score calculation. On a practical level, it is also easier for managers to understand and operate. For multiple evaluators participating in the evaluation process, the arithmetic average can be taken as the final score.

## 4. Index Weighting and Comprehensive Scoring Method

### 4.1. Index Weight Measurement Method Based on EWM

In order to strike a balance between subjectivity and objectivity, the Entropy Weight Method (EWM) is used to calculate the weight of the sub-index. As an objective weighting method, EWM derived from information theory determines the weight of each index according to the order degree of information contained in each index (Dong et al., 2010). Based on the rule of EWM, the index weight is inversely proportional to its entropy value (Wu et al., 2021). The EWM can avoid the interference of human factors and make the evaluation result more objective.

EWM needs to complete 4 stages of work, including dimensionless processing of indexes, data standardization, calculation of index entropy, and calculation of index entropy weight (Li et al., 2022).

Table 3. Scoring criteria.

| Sub-index | Index measurement standard | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| TC | The highest frequency | High frequency | Normal frequency | Low frequency | Lowest frequency |
| OLI | Very low | Lower | Normal | Higher | Very high |
| AD | Free registration | Lax audit | Routine audit | Strict audit | Invite admission |
| UDS | Very easy | Easy | Normal | Difficult | Very difficult |
| FVE | Very low | Lower | Normal | Higher | Very high |
| IIT | Very low | Lower | Normal | Higher | Very high |
| OCP | Very low | Lower | Normal | Higher | Very high |
| NCRI | Very slow | Slow | Normal | Fast | Very fast |
| NCDL | A long time | Relatively long time | Normal | Relatively short time | A short time |
| STAL | Little attention | Less attention | Normal | More attention | Huge attention |
| IRS | Very low | Lower | Normal | Higher | Very high |
| VVD | Very slow | Slow | Normal | Fast | Very fast |

Step one: Dimensionless processing of indexes

The entropy weight method needs to standardize the index raw data $X_{ij}$ first. Although the index measurement method proposed in this paper has been unified with the 5-point standard, as a special case of multi-dimensional data, the first stage of entropy weight method can still be carried out. For the positive index and the negative index, the dimensionless processing is carried out by Equation (1) and Equation (2) respectively.

$$Y_{ij} = \frac{X_{ij} - \min\left(X_j\right)}{\max\left(X_j\right) - \min\left(X_j\right)} \tag{1}$$

$$Y_{ij} = \frac{\max\left(X_j\right) - X_{ij}}{\max\left(X_j\right) - \min\left(X_j\right)} \tag{2}$$

where $Y_{ij}$ for $X_{ij}$ dimensionless processing of data, $\max\left(X_j\right)$ and $\min\left(X_j\right)$ are the maximum and minimum values of the *j* index, respectively.

Step two: Data standardization

After the initial adjustment of the PVC evaluation indexes, the data will continue to be standardized, and the standardization is based on Equation (3).

$$P_{ij} = \frac{Y_{ij}}{\sum_{i=1}^{n} Y_{ij}} \tag{3}$$

Step three: Calculation of index entropy

Before determining the weight of a specific index, Equation (4) should be used to calculate the entropy of a specific index as an important basis for subsequent weight calculation.

$$e_j = -\frac{1}{\ln n}\sum_{i=1}^{n} p_{ij} \ln p_{ij} \tag{4}$$

Step four: Calculation of index entropy weight

At the end of weight calculation, Equation (5) is used to calculate the entropy weight of a specific index. This is an objective weight. All the sub-index weights of PVC information dissemination efficiency are derived from the above process.

$$EW_j = \frac{1-e_j}{\sum_{j=1}^{m}\left(1-e_j\right)} \tag{5}$$

Based on the above process, the entropy weights of the sub-indexes will be calculated to represent the relative importance of each sub-index under the evaluation criteria. If the evaluated PVCs are determined, the calculated entropy weights are stable, but when the evaluated PVCs change, the entropy weight needs to be re-calculated.

### 4.2. Calculation Method of Information Dissemination Efficiency Based on TOPSIS

Due to its intuitive expression effect, convenience and flexible cooperation with other research methods, the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) has been widely used in the field of Multi-Criteria Decision-Making (Mathew et al., 2022; Ciardiello & Genovese, 2023). This includes but is not limited to, e-commerce, industry, health, solid waste management, supplier selection, cloud computing, risk management, renewable energy, water management, and climate change (Zavadskas et al., 2016; Zyoud & Fuchs-Hanusch, 2017).

TOPSIS constructs ideal solutions (positive ideal solutions and negative ideal solutions) for Multi-Criteria Decision-Making, then calculates the Euclidean distance between the evaluation object and the ideal solution, and ranks the advantages and disadvantages of the evaluation object (Behzadian et al., 2012).

The formation of the final evaluation conclusion of PVC information t dissemination efficiency needs to complete four stages of work under the framework of TOPSIS, including the construction of the weighted matrix, the construction of the ideal solution of the evaluation object, the calculation of the Euclidian distance between the object and the positive and negative ideal solution, and the calculation of the relative proximity between the object and the ideal solution. In the evaluation process of dissemination efficiency, the evaluation object refers to each PVC that is compared horizontally.

Step one: Construct a weighting matrix

Combined with the data processing steps of the entropy weight method, normalization of the evaluation index data of standardized processing is continued, as shown in Equation (6). Then, the normalized matrix is weighted by Equation (7), and the weighted standardized matrix $Z_{ij}$ is obtained.

$$Y'_{ij} = \frac{Y_{ij}}{\sqrt{\sum_{i=1}^{n} Y_{ij}^{2}}} \tag{6}$$

$$Z_{ij} = W_j Y'_{ij} \tag{7}$$

Step two: Construct the ideal solution for the evaluation object

Firstly, the positive ideal solution $Z^+$ of the evaluation scheme is constructed. $Z^+$ is composed of the maximum value of each column of data in the matrix $Z$. Next, the negative ideal solution $Z^-$ of the evaluation object is constructed, which $Z^-$ is composed of the minimum values of each column of data in the matrix $Z$.

Step three: Calculate the Euclidean distance between each object and positive and negative ideal solution

The Euclidean distance between each evaluation object and the positive and negative ideal solution is calculated separately. $D_i^+$ is the Euclidean distance between the $i$th evaluation object and the positive ideal solution, which can be calculated by Equation (8). $D_i^-$ is the Euclidean distance between the $i$th evaluation object and the negative ideal solution, which can be calculated by Equation (9).

$$D_i^+ = \sqrt{\sum_{j=1}^{m} \left(Z_j^+ - Z_{ij}\right)^2} \tag{8}$$

$$D_i^- = \sqrt{\sum_{j=1}^{m} \left(Z_j^- - Z_{ij}\right)^2} \tag{9}$$

Step four: Calculate the relative proximity $C_i$ of each evaluation object to the ideal solution

The relative proximity $C_i$ between each evaluation object and the ideal solution can be calculated by Equation (10). The greater the value $C_i$, the closer the $i$th evaluation object is to the positive ideal solution, that is, the higher the priority of the evaluation object. Finally, according to the size of $C_i$ the value, each evaluation object is sorted and the evaluation result is given.

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-} \tag{10}$$

Based on the above steps, the index system proposed in this paper can be used to measure and rank the relative level of information dissemination efficiency between the evaluated PVCs.

## 5. Example Verification

### 5.1. Example Illustration

The evaluation of PVC information dissemination efficiency has the characteristics of multi-criteria decision-making. The difficulty of evaluation is to include different categories of PVCs under the same analytical framework. In order to verify the feasibility of the evaluation method, 8 calculation examples of typical PVC were designed. The PVCs involved in the calculation examples are typical

network social media for Chinese college and university students. The topics chosen for PVCs relate to common areas of student study and life. Information content includes text, pictures, audio, video and other forms.

Example A comes from a PVC in Baidu Post bar, and the members mainly discuss the topics of campus study and life here. Example B is a course learning QQ group in a university, whose main function is to publish teaching information and discuss the course content. The QQ group members include both teachers and students. Example C is the official microblog of a sports event, which mainly publishes information related to the event and provides a platform for fans to interact. Example D and E are two home pages of Bilibili uploaders. The main content is to make and share video information of interest to college and university students, including knowledge learning of a course and sharing of a class on research methods. There are obvious opinion leaders in such PVC, and information communication is asymmetrical. Example F is an employment information exchange group for graduate students, mainly to help members share employment information and understand the university situation. Example G comes from a blogger of a professional scientific research forum. He provides various students with guidance and suggestions for writing scientific research papers and builds discussion channels. The members are mainly graduate students studying for a master's degree or a doctoral degree. Example H is a discussion channel created in a well-known portal website about university life and activities. The students participating in the discussion on this kind of PVC come from all over the country, and the characteristics are quite different.

In the above examples, PVCs in three channels, including social software, professional platform and portal website, have excellent coverage and can compare the information dissemination efficiency level and differences between various PVCs as far as possible. Because the purpose of the sample selection was to verify feasibility, three evaluators were selected to score the sample, including a researcher, a PVC operator, and a university student administrator. The final score was derived from a group discussion among the above evaluators. Based on the index assignment method proposed in this paper, the original score values of eight examples are shown in Table 4.

### 5.2. Evaluation Index Weight Calculation

The entropy weight method is used to assign weights to indicators. Based on the scores of 8 examples under each index, the final calculation results of index entropy $e_j$ and weight $EW_j$ are shown in Table 5.

### 5.3. Information Dissemination Efficiency Scoring and Ranking

After the objective index weights are formed based on the data from 8 examples, the TOPSIS method is used to calculate the information dissemination efficiency level of each example. By calculating the distance $D_i^+$ and $D_i^-$ from each PVC to the positive and negative ideal solution separately, the TOPSIS score was formed, as shown in Table 6.

Table 4. Example score.

| Sub-index | Examples | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H |
| TC | 2 | 5 | 5 | 3 | 4 | 4 | 5 | 5 |
| OLI | 2 | 5 | 4 | 3 | 5 | 3 | 5 | 5 |
| AD | 1 | 5 | 1 | 1 | 1 | 5 | 1 | 1 |
| UDS | 4 | 2 | 3 | 4 | 3 | 3 | 3 | 1 |
| FVE | 3 | 2 | 2 | 3 | 3 | 3 | 5 | 5 |
| IIT | 1 | 5 | 1 | 1 | 1 | 4 | 1 | 1 |
| OCP | 2 | 5 | 1 | 2 | 1 | 5 | 1 | 1 |
| NCRI | 4 | 2 | 2 | 3 | 3 | 1 | 4 | 2 |
| NCDL | 4 | 3 | 3 | 2 | 4 | 1 | 1 | 2 |
| STAL | 3 | 5 | 3 | 4 | 3 | 3 | 3 | 2 |
| IRS | 3 | 4 | 4 | 1 | 4 | 3 | 4 | 1 |
| VVD | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 |

Table 5. Entropy and weight of evaluation index of PVC information dissemination efficiency.

| | TC | OLI | AD | UDS | FVE | IIT |
|---|---|---|---|---|---|---|
| $e_j$ | 0.989 | 0.987 | 0.974 | 0.991 | 0.985 | 0.978 |
| $EW_j$ | 0.061 | 0.071 | 0.145 | 0.052 | 0.085 | 0.120 |
| | **OCP** | **NCRI** | **NCDL** | **STAL** | **IRS** | **VVD** |
| $e_j$ | 0.978 | 0.989 | 0.985 | 0.991 | 0.984 | 0.989 |
| $EW_j$ | 0.121 | 0.062 | 0.084 | 0.049 | 0.088 | 0.061 |

Table 6. Evaluation scores and ranking of PVC examples.

| Example | Positive ideal point distance | Negative ideal point distance | TOPSIS score | Ranking |
|---|---|---|---|---|
| B | 0.064 | 0.183 | 0.741 | 1 |
| F | 0.082 | 0.159 | 0.660 | 2 |
| G | 0.174 | 0.090 | 0.339 | 3 |
| A | 0.166 | 0.081 | 0.328 | 4 |
| E | 0.170 | 0.082 | 0.326 | 5 |
| H | 0.179 | 0.073 | 0.291 | 6 |
| C | 0.177 | 0.072 | 0.289 | 7 |
| D | 0.170 | 0.056 | 0.249 | 8 |

It can be found that using the comprehensive scoring method based on EWM and TOPSIS, the information dissemination efficiency of different PVCs can be accurately calculated and compared with each other.

## 6. Conclusions

As a kind of social channel widely used by young users in the Internet era, PVC plays an important role in the process of college and university students collecting and disseminating information online. The high degree of topic focus, fragmented information forms, and relatively closed communication environment all bring difficulties in revealing the law of PVC information dissemination. Existing studies mainly focus on the disclosure of PVC information dissemination rules, but there is little exploration of the measurement method of PVC information dissemination efficiency. To distinguish the differences in the efficiency of different PVCs information dissemination has a strong positive significance for facilitating the PVC classification management of the operator and improving the user experience of students. This kind of research has high timeliness value.

Based on the PVC usage habits of Chinese college and university students and the basic characteristics of PVC operation, this paper designs an evaluation index system of PVC information dissemination efficiency. The index system includes two basic categories: static index and dynamic index, which measure the characteristic strength of PVC and the speed of information production and propagation respectively. Specifically, 12 sub-indexes have been designed to measure the overall efficiency of PVC information dissemination. By means of the weighting method based on the entropy weight method and the comprehensive calculation and ranking method based on TOPSIS, the information dissemination efficiency of college and university students' PVC is measured. Considering the channel type, social influence and information characteristics, 8 typical PVC examples were selected.

By means of the information dissemination efficiency measurement method proposed in this paper, the index assignment, weight calculation, dissemination efficiency measurement and result ranking of the examples are carried out respectively, which proves that the method proposed in this paper can realize the measurement and horizontal comparison of the information dissemination efficiency of PVC. The research results of this paper have excellent reference value for PVC operators to optimize the information promotion strategy and university managers to improve the student service system.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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