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MAPPING THE DIGITAL FOOTPRINTS OF SCIENCE TEACHERS IN CHINA: A YOUTUBE NETWORK ANALYSIS

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Abstract: *This study examines the social media networks of science teachers in China on YouTube through the application of NodeXL-based social network analysis. By identifying key structural patterns and interaction dynamics, the research aims to reveal how science teachers engage, communicate, and develop professionally within social media environments. Using a mixed-methods approach that integrates quantitative network metrics with qualitative content analysis, the study explores information diffusion processes and thematic trends among Chinese science educators on YouTube. The findings indicate significant regional disparities in China's science education infrastructure, persistent biases in international media portrayals of experimental science conditions in China, and strong public interest in qualification requirements for foreign science teachers working in the country, which emerged as the most prominent discussion topic. Through visual network mapping, this study illustrates the embedded positions of science teachers within YouTube-based social networks and provides insights into their professional development trajectories, school and employment environments, and approaches to science curriculum implementation. Overall, this research offers a novel social media-based perspective for understanding the dynamics of science teachers in China and contributes methodological value to studies of teacher development and educational quality in the digital era.*

Keywords: *Social media, Social media network analysis, NodeXL, Science teachers in China, Information diffusion*

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Introduction

As key facilitators of knowledge dissemination, science teachers serve as critical indicators for evaluating the effectiveness of institutional science education ecosystems (Wilson, 2013). In China's multilevel education system, science instruction spans from primary through junior secondary, senior secondary, and tertiary levels. Although YouTube remains geographically restricted in mainland China, global audiences—including overseas Chinese communities and international observers—actively engage in discussions about Chinese education on the platform. These discussions reflect a broader interest in topics such as pathways to teaching qualification in China and the professional practices of science teachers, highlighting the interpretive value of social media data for educational research. Prior studies have demonstrated that YouTube serves not only as a complementary learning tool in formal education contexts but also as a site of emergent educational networks that can be analyzed using Social Network Analysis (SNA) (e.g., Pasquel-López, Rodríguez-Aceves & Valerio-Ureña, 2022; International Journal of Management Education, 2018).

Social Network Analysis (SNA) is a methodological framework for studying relationships, interactions, and structural patterns among actors within a network (Wasserman & Faust, 1994). In the context of social media, SNA focuses on the connections between users, content, or communities, treating these as nodes and edges within a network. Unlike traditional research methods that examine individual attributes or content in isolation, SNA emphasizes relational structures, capturing how information flows, how influence is distributed, and how communities or subgroups emerge. Social media platforms, such as YouTube, Twitter, and Facebook, generate rich, large-scale interaction data that are particularly well suited for SNA. Users' comments, replies, mentions, likes, and shares can all be represented as network ties, allowing researchers to quantify engagement, identify influential actors, and visualize patterns of discussion (Hansen, Shneiderman, & Smith, 2011). By integrating network metrics—such as centrality, density, and clustering—with content or thematic analysis, SNA provides a multidimensional understanding of online discourse, enabling insights into how knowledge is disseminated, communities form, and public perceptions develop.

Literature Review

The emergence of social media, including social networking technologies, has had a profound impact on almost all human activities (Onyancha, 2015). YouTube has become the most successful Internet website providing a new generation of short video sharing service and has had a great impact on Internet traffic, since its establishment in early 2005 (Cheng, Dale & Liu, 2008). NodeXL is that it requires no technical and/or programming knowledge which potentially allows it to be utilised across a wide range of disciplines from science and engineering, the social sciences and the humanities (Ahmed & Lugovic, 2018). This study selected the Web of Science (WOS) database of the Institute for Scientific Information (ISI) in the United States (with the time span selected from 1993 to 2025) as the entry point and obtained 45 valid English literatures.

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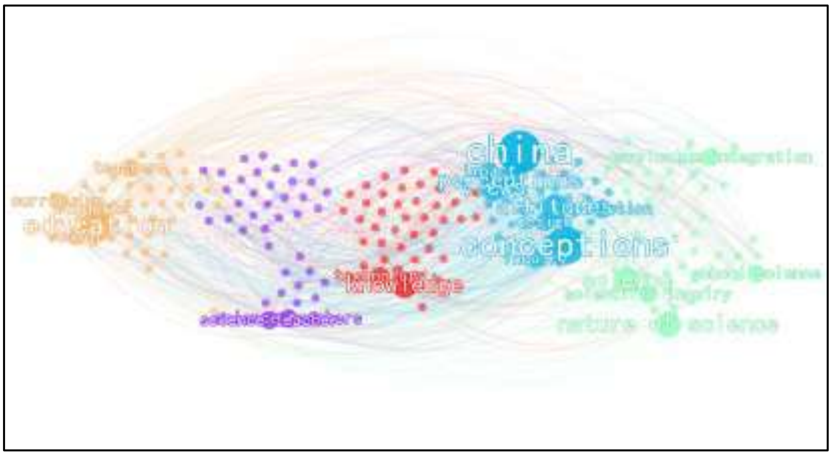

Figure 1: Co-occurrence clustering map of research topic keywords

An old Chinese proverb states, “A learned person makes a qualified teacher,” encapsulating the traditional belief that subject-matter expertise alone qualifies one to teach. This conception has long influenced expectations of teachers in China, placing greater emphasis on content knowledge than on pedagogical proficiency (Zhong & Wu, 2004). As a result, science education in China three decades ago was predominantly teacher-centered, characterized by didactic instruction, a heavy focus on theoretical content, and an examination-oriented approach (Wang, Wang, Zhang, Lang, & Mayer, 1996).

From a cultural and systemic perspective, Wang et al. (1996) observed that traditional values have shaped the professional backgrounds of science teachers in China, particularly at the primary level. Due to the absence of specialized training programs, science is often taught by teachers with degrees in mathematics or physics, rather than by graduates with formal science education backgrounds (Zhao, 2014). This lack of disciplinary alignment contributes to limited interdisciplinary integration in the science curriculum and undermines instructional effectiveness. Furthermore, many teachers demonstrate insufficient capacity to design and deliver content that integrates scientific, technological, and societal dimensions, as well as to facilitate scientific inquiry and experimentation. These limitations further constrain the quality and effectiveness of integrated science education (Sun, Wang, Xie, & Boon, 2014).

Gao (1998) examined the impact of various cultural influences—namely the Confucian educational tradition, communist ideology, the psychological characteristics of the Chinese people, and linguistic factors—on science teaching and learning in Chinese schools. These cultural dimensions were found to contribute to substantial differences in the goals of school science curricula, the intensity of examination pressure, the roles and perceptions of teachers, pedagogical beliefs and practices, student learning strategies, and interpretations of scientific terminology (Gao et al., 1998). Liu et al. (2015) further argued that teacher education in China is deeply shaped by traditional cultural values, Confucian principles, and the dynamics of rapid socioeconomic development. These forces collectively drive national policy initiatives, the design of teacher education systems, and various programs aimed at cultivating an adequate supply of qualified science teachers across all levels of schooling. While these teachers face the complex challenges brought by ongoing science education reforms, they also encounter opportunities to implement the new science curriculum effectively—thereby fostering their professional growth and contributing to the overall enhancement of science education quality.

Zhang et al. (2015) highlighted that, despite the absence of a consistent relationship between teacher-related variables and students' science performance in China, school-level socioeconomic status (SES) plays a significant role. Their study revealed pronounced disparities in access to high-quality teachers between schools with high and low SES, leading to inequities in educational opportunity and student outcomes (Zhang & Campbell, 2015).
After three decades of reform in science education, the attitudes of science teachers have undergone notable transformation (Wang et al., 1996). Despite their relatively limited academic backgrounds in science, many teachers place high value on professional development through curriculum planning, systematic training, and the exchange of teaching experiences. They maintain a strong belief that, through international exchange and mutual learning, China can address its educational limitations, leverage its strengths in science education, and cultivate distinctive characteristics—particularly through the implementation of extracurricular science activities and the active involvement of parents (Wang et al., 1996).

With regard to attitudes toward science teaching, Oon et al. (2019) observed that although early childhood educators in China generally support child-centered learning approaches, many feel uneasy when designing science activities that effectively engage young children. This discomfort often stems from a lack of confidence in their own abilities as science educators and a self-perceived deficiency in scientific knowledge, ultimately undermining the quality and effectiveness of science instruction. Similarly, Zhan et al. (2021) emphasized that in China, the integration of engineering education into science curricula is widely regarded as a promising strategy for strengthening STEM education. However, teacher-related challenges—such as limited training, inadequate pedagogical preparation, and insufficient interdisciplinary competence—have impeded the successful implementation of integrated STEM education, posing significant implications for both teacher education and classroom practice.

Methods

Social Network Analysis (SNA) is a methodological approach used to examine relationships and interaction patterns among social actors, such as individuals, groups, or organizations, by representing them as networks composed of nodes and ties. Nodes represent actors within the network, while ties indicate relationships or interactions between them, such as communication, collaboration, or information exchange (Wasserman & Faust, 1994).

NodeXL, an open-source extension for Microsoft Excel (2007-2016 versions), is a powerful tool for social network visualization and analysis (Ahmed & Lugovic, 2019). This software enables the generation of network graphs that reveal critical structural patterns, including key actors, community clusters, network divisions, bridging connections, and thematic resource distributions. In the present study, it employed NodeXL to examine the social network structure of science teacher in China' discourse on YouTube. The analytical approach focused on: (i) conducting single-video analyses of the ten most influential videos, (ii) examining force-directed network layouts, and (iii) generating comprehensive network reports to identify discussion patterns and information flow dynamics.

In this study, Node XL was used to analyze the social network of videos or creators in YouTube with the keyword "Science teachers China". The data includes science teachers from all academic sections, about 20000 data import from YouTube. The purpose of this paper is to provide an overview of NodeXL in the context of videos in YouTube discussion science teachers in China, it presents the relevant dynamics of the current teaching quality of subject education in China, the cultural factors of science education, and the attitudes of science

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teachers in China towards science teaching. This study will answer the following questions through NodeXL by reporting network metrics.

Table 1: Data Analysis

Research Question	Network Metrics	Reason to use
RQ1: How did topic of science teachers in China spread across the YouTube?	User to user video comment network	By analyzing user-to-user interactions rather than user-to-content relationships alone, the study captures the social dimension of discourse and identifies influential participants and interaction clusters within the comment ecosystem.
RQ2: How to focus on the content of the top ten influential video discussions?	Out-degree analysis	Users with high out-degree centrality are often highly active contributors who stimulate discussion, disseminate information, or challenge existing viewpoints.
RQ3: What is the current hot topic of discussion science teachers in China on YouTube's social network?	Single video network analysis	This approach enables comparison across videos to identify how different topics generate distinct interaction structures. It also helps isolate the influence of video content on user engagement and network configuration.
RQ4: What are the aspect that attracts the most attention at present about science teachers in China on YouTube's social network?	Single video network analysis	

The user-to-user video comment network models interactions among YouTube users based on commenting behavior. In this directed network, nodes represent users, and edges represent comment or reply relationships between users under videos related to science teachers in China. This network structure enables the examination of conversational dynamics, user engagement patterns, and the formation of discussion communities. The out-degree centrality measures the number of outgoing ties from a node to other nodes in a directed network. In the context of a user-to-user comment network, out-degree reflects the extent to which a user actively engages with others by initiating comments or replies. Single video network analysis focuses on the interaction network formed around an individual YouTube video. In this network, nodes represent users who commented on the video, and ties represent reply or mention relationships within the comment thread. Analyzing networks at the single-video level allows for detailed examination of micro-level interaction patterns, such as conversational depth, polarization, and thematic concentration.

By analyzing multiple single video networks, the study compares structural differences across videos addressing different themes related to science teachers in China. Network metrics such as density, centralization, and clustering are used to assess variations in audience participation and discussion intensity. Cross-video comparison provides a systematic way to link content

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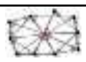
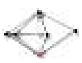
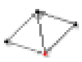
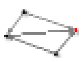
characteristics with interaction dynamics, strengthening the interpretive power of the findings and supporting more nuanced conclusions about public discourse on science education.

Results

The dataset represents a network of YouTube videos whose titles, keywords, descriptions, categories, or author usernames contain the phrase "Science teacher China". The network was limited to the top 100 videos based on the specified criteria. In this network, degree refers to the number of connections associated with each node. For directed networks, degree is further categorized into in-degree (the number of incoming links) and out-degree (the number of outgoing links). To identify the most influential videos, nodes were sorted in descending order by out-degree, and the top ten were selected. Edges in the network represent pairs of videos that have been commented on by the same user, thereby indicating shared audience engagement. The graph's vertices (i.e., videos) were grouped into clusters using the Clauset-Newman-Moore community detection algorithm, which identifies densely connected subgroups within the overall network structure.

Table 2: Overview of Top 10 Vertices

Top	Vertex	Subgraph	Subtitles	Subscription volume (tens of thousands)	Page views (tens of thousands)
No.1	Gyx0A0BL4Gc		How China Is Using Artificial Intelligence in Classrooms | WSJ	620	398
No.2	c3jly1QDRbc		The Science of Teaching, Effective Education, and Great Schools	186	64
No.3	nvUvJAm_CFI		Science Teacher Gives Amazing Lectures	37.8	8.1
No.4	P_cI2X_17aM		Science Teacher in Rural Henan Inspires Many with Creative Experiments, Commitment	62.7	1
No.5	aLhx_K1tOzo		Amazing Science Teacher in China	100	2.2
No.6	xyI2yjwaZ60		Chinese Physics Teacher Plays 'Twinkle Twinkle Little Star' on Beakers	327	1.1
No.7	dMKSHMBMkFQ		Chinese Science Teacher Inspires Many with Creative Experiments	3.81	1.69
No.8	sUlZzEZ9y0g		Teacher Teaching Science In ChinaCN	5.31	5.12

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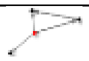
No.9	Y7dRuYKcmEg		E7|Filipion Science Teacher in China + His Proudest Filipion Moment | So, Precious!	0.4080	0.1161
No.10	Rr8CGCfVWzA		Filipino Science Teacher in China | Journey to Hangzhou	0.3260	0.0418

The analyzed videos highlight several recurring themes in Chinese science education on YouTube. First, there is increasing attention to the use of advanced classroom technologies, such as AI cameras and brain-wave monitoring, which elicit mixed reactions from students regarding academic pressure and stress. Second, the videos emphasize the critical role of high-quality, innovative teachers in promoting student engagement and learning outcomes. Featured teaching practices include hands-on experiments, interdisciplinary approaches, and creative use of everyday materials, with rural and urban teachers alike demonstrating resourcefulness and adaptability. Third, cross-cultural perspectives are represented by Filipino teachers working or preparing to work in China, offering insights into motivations, expectations, and challenges in foreign teaching contexts. Overall, the videos collectively illustrate how technology, pedagogy, and teacher creativity intersect in shaping both domestic and international perceptions of science education in China.

The top-ranked video focuses on the increasing adoption of artificial intelligence (AI) cameras and brain-wave monitoring devices in Chinese classrooms. While these technologies are often promoted by educators and parents as tools for enhancing academic performance and classroom management, student responses reveal notable concerns, with some describing heightened anxiety and psychological pressure associated with continuous monitoring. The second-ranked video underscores the pivotal role of high-quality teachers in promoting student achievement, featuring a science teacher whose diverse interests are reflected in hands-on instructional practices, such as launching water rockets and constructing Mars rover models. The third, fourth, and seventh videos center on the same science teacher from a rural village in Henan Province, central China, who has gained widespread attention for fostering creativity through interactive experiments. By repurposing discarded everyday materials into effective teaching tools, this teacher exemplifies resourcefulness in science education under constrained conditions. The fifth video documents a classroom experiment in which students are asked to inflate an empty plastic bag using only their breath, illustrating fundamental principles of air pressure and volume. The sixth video presents an interdisciplinary instructional approach, in which a science teacher integrates music to explain factors influencing sound production in water. The eighth video features a live classroom demonstration explaining electricity generation through friction, reinforcing abstract scientific concepts through experiential learning. The ninth video consists of an interview with a Filipino science teacher currently working in China, offering personal reflections on cross-cultural teaching experiences. Finally, the tenth video provides a self-narrated account by a Filipino science teacher preparing to begin his teaching career in China, highlighting motivations, expectations, and perceptions of teaching in a foreign educational context.

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Conclusion and recommendations

The top ten influential YouTube videos primarily focus on various aspects of science teaching in China. These include the pedagogical approaches adopted by Chinese science teachers, perceptions of the professional role of science educators, experiences shared by foreign science teachers working in China, and teachers' attitudes toward science instruction. Through the lens of social media, these videos offer a unique and accessible window into the current landscape of science education in Chinese schools. Analysis of these videos reveals several recurring themes and key characteristics regarding the environment surrounding science teachers in China:

The science education environment in China exhibits significant regional disparities. In rural areas, there is a persistent shortage of experimental materials and inadequacies in laboratory facilities and equipment. Many schools lack dedicated science laboratories and professionally trained experimental science teachers. As a result, rural science educators often rely on repurposed or discarded materials as substitutes for standard experimental tools. This resource limitation presents a dual dynamic. On the one hand, the lack of appropriate experimental resources hinders the effective delivery of science instruction. On the other hand, the creative use of waste materials offers opportunities to cultivate students' hands-on skills and foster their innovative thinking. Among the top ten most influential YouTube videos analyzed, six feature real classroom footage of science instruction in China. Notably, the experiments conducted by Chinese science teachers frequently take place not in fully equipped laboratories, but in regular classrooms or even outdoor spaces such as playgrounds. These examples highlight how Chinese science teachers, particularly in under-resourced settings, are able to maximize the utility of limited materials to actively engage students and stimulate their creativity in meaningful ways.

Foreign media and social media audiences sometimes exhibit biased perceptions regarding the state of science education and experimental conditions in China. In one widely viewed video—posted by an account with 3.27 million subscribers—a Chinese science teacher demonstrates the principles of sound by tapping a water-filled glass to produce musical tones. A highly popular comment under the video reads: "Western media title: Poor Chinese teacher can't afford to buy a musical instrument. Or: Chinese student forced to play music with glass cups." While intended as humorous satire, the comment garnered the highest number of likes and replies, suggesting strong engagement from viewers. Despite its comedic tone, the comment reveals underlying prejudices and misinterpretations regarding the improvisational nature of science teaching in China. Rather than being a sign of inadequacy, such resourceful demonstrations often reflect the teacher's creativity and adaptability in contexts where material resources are limited. This example highlights the complex ways in which social media content can both disseminate educational innovation and, at the same time, reinforce cultural stereotypes or misconceptions.

In addition to domestic science educators, foreign science teachers working in China have also attracted considerable attention on social media platforms. Among the most frequently discussed topics is the process of obtaining the necessary qualifications to teach science in China. According to an interview summary with Filipino primary school science teachers currently working in China, it was revealed that their salaries are approximately eight times higher than those offered in the Philippines. In addition to competitive salaries, these teachers often receive supplementary benefits such as housing allowances, meal subsidies, and transportation support. The interview also highlighted key differences in educational systems. Science education in the Philippines tends to emphasize stratified guidance and theoretical

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instruction, yet lacks sufficient focus on practical application. In contrast, science curricula in China are grounded in foundational concepts and prioritize conceptual understanding and hands-on experimentation over rote memorization. Curriculum design in Chinese science education reflects a strong emphasis on applicability and active learning.

One video that received widespread attention featured a Filipino science teacher who had previously worked in the United States for two years. He ultimately chose to decline further opportunities in the U.S. in favor of accepting a teaching position in China. Although the video does not explicitly detail the reasons behind this decision, the teacher's self-narration—"I'm not approaching on the good reasons which are be closing on the next one"—along with his statement about "not wanting to waste time and money", suggest practical motivations related to salary, benefits, or cost of living. This implies that Chinese schools may offer working conditions, career development pathways, or lifestyle advantages that align more closely with the expectations of foreign educators—factors significant enough to influence decisions over international career opportunities.

Video content reveals that many primary schools in Futian District, Shenzhen, are equipped with state-of-the-art teaching facilities and maintain a diverse team of international educators. These schools represent a progressive model of science education, integrating global teaching resources with local cultural contexts. In interviews, foreign teachers shared insights and recommendations for effective science instruction in Chinese classrooms. Kim emphasized the importance of culturally responsive teaching, suggesting that adapting science content to students' cultural backgrounds—such as incorporating elements of Chinese tradition and daily life—can enhance engagement and relevance. This approach helps bridge the gap between abstract scientific concepts and students' lived experiences. Georgia highlighted the need for age-appropriate instructional strategies, noting that science educators must adapt their teaching methods to suit different developmental stages, from kindergarten to middle school. For younger learners, she stressed the importance of interaction, play-based learning, and patient guidance. In contrast, older students benefit from more autonomous learning activities, such as utilizing library resources and conducting independent inquiries.

Across various grade levels, interactive teaching methods were cited as essential. In early primary education, science concepts are reinforced through songs, games, and hands-on activities, fostering curiosity and foundational understanding. As students' progress, these methods evolve into more student-led learning experiences, promoting deeper inquiry and critical thinking.

These findings indicate that science education in China is undergoing a period of dynamic transformation, influenced by both internal reforms and global educational trends. The science education environment in China varies greatly from region to region. Foreign media have biases against the current situation of science education in China. Foreign science teachers teaching in China have also received widespread attention, and how to obtain the qualification for the position has been the most discussed topic. In terms of teacher recruitment in the future, emphasis can be placed on the salary and benefits as well as career development opportunities of international schools in China. In terms of cross-cultural training, it is necessary to help foreign teachers overcome differences in language and teaching methods.

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