

A Comparative Study on the Roles of Science Teachers Published in English and Chinese

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ABSTRACT

Science teachers play a crucial role in the science education system, significantly influencing the development of students. However, existing research highlights issues such as a wide age span and uneven quality among science teachers, which undermines the effectiveness of science education. In addition, the role of science teachers can be ambiguously defined, leading to confusion about their responsibilities. To better understand the current situation and future development trend of research on the role of science teachers in China and overseas, this study compares and analyses a total of 30 documents on the role of science teachers in Chinese or English. The documents were from Web of science or CNKI databases. Content analysis was applied on time of publication, volume of papers, research topic, and similarities and differences of the role development of science teachers in China or overseas. Results show that: (1) At present, the development trend of research on the role of science teachers published in English and Chinese is relatively slow and has not received due attention. Most mainstream research paradigms are still in the stage of theoretical exploration; (2) the research theme of the role of science teachers mainly includes five aspects: Role expectation, role orientation, role identification, role transformation, and role; (3) the “should be” research published in Chinese and the “real” research published in English should be combined and form a positive interaction. This study is helpful to systematically analyze the current situation of research on the role of science teachers, with a view to providing a basis for subsequent research on the role of science teachers.

KEY WORDS: Comparative research; content analysis; the role of science teachers

INTRODUCTION

Science teachers play a crucial role in the science education system, significantly influencing the development of students (Cohen and Patterson, 2012; Davidson et al., 2022). Given the important role of science teachers in supporting science education reform and instructional delivery, we believe that it is important to identify the different role science teacher's play in teaching and learning and to focus on research on the role of science teachers in science education.

Social roles are viewed as norms and behavioral patterns of rights and obligations corresponding to a particular identity of a person or a group (Lynch, 2007). When a person or a group of people has a particular identity and status, there are expectations about his or their behavior. Educators occupy a distinct social role and are therefore held to specific responsibilities and expectations. It is therefore essential that those entering the teaching profession fully comprehend the essence of the teacher's role and are able to competently embody that role. This is a crucial requirement for the process of teacher socialization and for advancing modern educational practices and instructional reforms. In this study, the role of science teachers refers to the norms and behavioral patterns of rights and obligations corresponding to the specific identity of science teachers.

A review of the current literature in both Chinese and English revealed a number of theoretical and practical explorations surrounding the study of science teacher role. These include the role identification of science teachers (Abualrob, 2019; Eick and Reed, 2002a), the roles influence of science teachers (Ibrahim et al., 2017), and the roles types of science teachers (Zhai and Tan, 2015a; 2015b). Moreover, recent literature reviews have contributed to a deeper understanding of the roles of science teachers. For instance, Zhai et al. (2024) highlighted the significance of science teacher identity in fostering teachers' professional growth, optimal teaching practices, and positive attitudes. Their review of the research literature on science teacher identity over the past two decades not only provided a comprehensive picture of the current state of the field but also indicated promising avenues for future research (Zhai et al., 2024). Another study employed the HistCite scientometric analysis tool to provide an in-depth exploration of 444 relevant papers included in the Web of Science database between 1986 and 2019. This focused on the role and functions of science teachers in inquiry-based teaching. These studies were subjected to exhaustive analysis in terms of multiple dimensions, including keyword frequency, time series of literature publication, geographic distribution, major research institutions, and diversity of published journals. This approach provided a comprehensive research perspective

and a well-developed research framework for the study of science teachers' role (Li and Yu, 2019).

However, the majority of current literature reviews on the role of science teachers focus on the use of knowledge graph analysis methods to present macro-level data distribution, such as the geographic region of the research sample, journals, authors, and research institutes. In contrast, the analysis of the details of the research, the process, and its in-depth content appears to be insufficient (Shen et al., 2019). This limits our ability to accurately grasp the full scope of science teachers' role. The current status quo may result in a fragmented understanding of the role of science teachers and make it challenging to define it clearly, which is not conducive to science education practitioners and researchers accurately grasping the role position and then effectively performing their duties in practice. Consequently, we posit that a retrospective study is imperative to elucidate and integrate the extant literature on the roles of science teachers. This endeavor necessitates a comprehensive examination of the research themes pertaining to the role of science teachers. By juxtaposing and analyzing the foci of Chinese and English literature, we can more clearly identify the foci and potential blind spots of science teacher role research in different cultural contexts. Such a comparison not only reveals the similarities and differences between the Chinese and English studies but also provides more concrete and practical guidance and insights for the professional growth of science teachers worldwide.

This study conducted a comprehensive review of the literature on the role of science teachers in China and the United States. It then developed a content analysis framework based on the role theory to analyze and interpret the literature in multiple dimensions. Based on the above, this study focuses on the following three issues:

1. What are the development trends of study on the role of science teachers published in English and Chinese?
2. What are the main themes of the study on the role of science teachers published in English and Chinese?
3. How does the research published in Chinese compare to the research published in English?

LITERATURE REVIEW

The role of teachers refers to the identity, status, responsibility, and corresponding behavior mode of teachers in the education system, which began to attract the attention of experts and scholars in the field of pedagogy in the early 1920s (Zhou, 2017). The role of teachers has always been concerned for researchers published in English and Chinese, and related research has also emerged in an endless stream. Studies published in English on the role of teachers mainly focus on descriptive research on the role of teachers, constructivist research on the role of teachers (Subramaniam, 2010), and comparative role expectations of teachers (Beishuizen et al, 2001). The research on the role of teachers in China can be divided into the description and summary of the overall role

of teachers (Zhou and Du, 2022), the role of teachers in the teacher–student relationship (Yau and Jia, 2011), and the role transformation of teachers (Li et al., 2022). In addition, it is worth noting that the research on the role of teachers in China also involves a lot of summary research, which is of positive significance for the promotion and deepening of the research on the role of teachers (Cheng and Liu, 2007; Gung, 2011; Wang, 2005; Xing and Niu, 2009).

Despite the increasing recognition of the vital role science teachers play in education, there remains a significant deficiency in research specifically devoted to exploring their roles and the consequent implications. Throughout the research on the role of science teachers by scholars at home and abroad, it is found that the main focus is on the role orientation of science teachers (Zhang, 2013), the role identity of science teachers (Eick and Reed, 2002b), and the type and influence of the role of science teachers (Zhai and Tan, 2015a; 2015b). Unfortunately, there is no special and systematic review of the role of science teachers, and it is also unable to effectively comb the existing research results to respond to what is expected of the role of science teachers? What is the role of cognition of science teachers? What has happened to the role? What are the factors that affect the role change? What kind of conflicts are faced in the process of transformation? How do individuals play the role of science teachers? and other specific issues.

RESEARCH DESIGN

Data Sources

Research samples are from CNKI and Web of Science databases. In the CNKI database, this research uses “the role of science teacher” as the keyword to conduct subject search. At the upper limit of search conditions, it is set as core journals, CSSCI journal database, and master's and doctoral dissertations. There is no time limit for publication, and 32 relevant documents are obtained. To accurately grasp the current research situation of the role of science teachers, this study further screened 32 documents. The screening criteria include (1) eliminate irrelevant documents such as newspapers, conference notices, and solicitation of contributions; (2) the research field is science education; and (3) the research object is the role of science or science teachers. Through the screening of documents, 18 effective documents related to the role of science teachers were finally obtained. Web of Science is a large comprehensive, multi-disciplinary, core journal citation index database. The SSCI database and A&HCI database included in its core collection contain most of the international top social science (including education) journal paper information. To effectively obtain high-quality English research literature on the role of science teachers, this study screened 66 papers in the Web of Science database with the retrieval type TS=(“science teacher role” OR “science teachers' roles” OR “the role of the science teacher”) and 12 papers were obtained after excluding irrelevant papers. Finally, there are 30 Chinese and English literature as the analysis object of this study.

Research Methods

Content analysis method

Content analysis is a research method that quantifies and describes the obvious communication content objectively and systematically. With its objective, systematic, and quantitative characteristics, content analysis is currently widely used to analyze text materials, summarize the current research situation in a certain field, and predict the future development trend (White and Marsh, 2006). This study adopts the content analysis method to carry out statistical analysis of Chinese and English literature.

The specific steps of this study are as follows (Kleinheksel et al., 2020): (1) Import 30 Chinese and English literature related to the science teacher role study into the Nvivo12 software, (2) create a detailed node structure in Nvivo12 based on a pre-designed content analysis coding system (the specific coding system will be described in detail in the next section), and (3) repeatedly read the abstracts of each article and browse the full text. To complete the node coding of the year of publication and the research topic of the literature, the following steps are required: (4) Use Excel and SPSS 22.0 to conduct statistics and analysis and draw conclusions through inference to explain the commonalities, differences, and potential developmental trends of the literature on the role of science teachers in both English and Chinese languages.

Comparative research method

This study uses the comparative research method to compare the development trend and main research topics of the research on the role of science teachers published in English and Chinese, hoping to get more enlightenment through the comparison.

Comparative research method refers to the research method of comparing two or more things or objects to find differences and similarities. Comparative research can be carried out from different perspectives such as time, space, and process. It mainly includes five steps: Determining the problems of comparison, determining the standards of comparison, collecting and sorting out data, comparative analysis, and drawing conclusions. This study uses the method of comparative analysis to compare the similarities and differences between the study published in English and Chinese on the development trend and research topics of the role of science teachers and points out the characteristics and focus of the two in the current research, so as to provide reference for the study of the role of science teachers in China and provide Chinese experience for the study of the role of international science teachers.

Content Analysis Coding System

This study carries out statistical analysis on the research samples from the two dimensions of the time of publication, the amount of papers, and the research topic and completes the coding and classification on the basis of reading the abstracts, keywords, and even the full text of each article.

Time and quantity of documents issued

This study analyzes the origin, development context, research status, and importance of the research on the role of science teachers through the time and volume of papers.

Research topic

The distribution and trend of research topics in the relevant literature published in English and Chinese can not only show the main categories of research on the role of science teachers to a certain extent but also reflect the focus areas of research. Therefore, the analysis of research topics is the difficulty and focus of this study. Through reading the related literature, it was found that there is no unified framework for analyzing the research topic of science teachers' roles. Role theory serves as a conceptual framework that links individuals to organizational attributes and describes the process of individuals' behaviors and interactions within a social structure (Wang et al., 2023; Brookes et al., 2007). Role theory suggests that every individual in a social system needs to play a corresponding social role and that the process of playing a social role generally goes through the stages of role learning, role expectation, role comprehension, and role practice (Hu et al., 2023; Zhou, 2021). In studying the role of science teachers, three questions need to be clarified first: "What should teachers do?," "How do teachers perceive what they should do?" and "What do teachers actually do?" that is, to answer the three basic questions of "role expectation of teachers," "role identification of teachers," and "role practice of teachers" (Cui, 2021). Therefore, when exploring the study of science teachers' roles, it is important to clarify the general process of science teachers' roles: Social development and educational changes bring new changes to science teachers' role expectations, and their role positioning and norms change, which affects science teachers' role identity, and when the role identity changes, it then generates the science teachers' role transformation, and there are role conflicts and adjustments in the process of transformation. With reference to the guiding framework of role theory (Fan, 2021) and based on the major research themes of the literature related to science teachers' roles, this study proposed an initial coding system for this study and conducted preliminary coding; then, based on the results of the preliminary coding, along with the abstracts, keywords, and full text of each piece of literature, the researcher analyzed and discussed the initial coding system, expanded the theme categories, merged the similar themes, and excluded and integrated the themes that did not match; finally, the research theme variables of this study were formed, as shown in Table 1.

FINDINGS

Based on the analysis of the summary and the full text of the relevant literature, this study extracts the relevant content of "science teacher role" into the analysis coding framework and finally obtains the time distribution and topic distribution of science teacher role research literature.

Table 1: Subject variables of science teacher role research

Category	Description
Role expectation of science teachers	The role expectation of science teachers refers to the behavior mode expected by the public and students or the behavior mode expected by teachers themselves (Zheng and Luo, 2016).
Role orientation of science teachers	The role orientation of science teachers refers to the behavior of science teacher groups or individuals through their own efforts in specific teaching practice according to specific teaching concepts and tasks (Yu, 2016). It is a dynamic process in which teachers constantly understand, experience, and innovate through communication with students and colleagues in education and teaching activities. This process includes research on the connotation and type of the role of science teachers, the role responsibilities and norms, the background and difficulties of role positioning, the influencing factors of role positioning (Liu, 2004), and the strategy of role positioning.
Role identification of science teachers	The role identity of science teachers refers to the role cognitive meaning system, as well as the role emotion, attitude, and will be presented by science teachers in specific educational situations based on their role participation and role interaction in their jobs (Zhang and Zhu, 2018).
Transformation of the role of science teachers	The role change of science teachers means that when some elements of education change, the behavior mode of science teachers will also change. At the same time, the role conflict and adjustment behavior of teachers may occur in this process.
Role influence of science teachers	It refers to the research on the impact of different types of science teachers' roles on students' learning effectiveness through empirical research and other methods

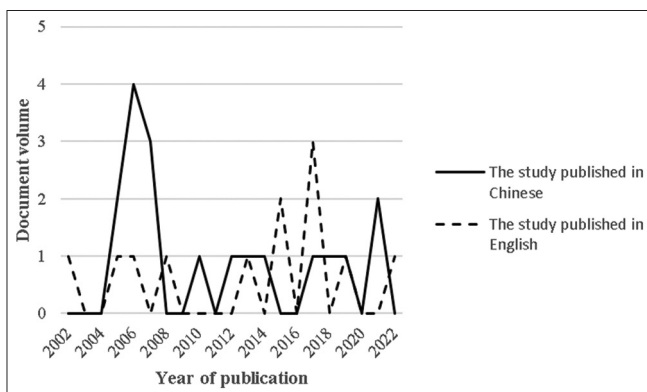


Figure 1: Time distribution of research literature on the role of science teachers published in English and Chinese

The Number of the Study on the Role of Science Teacher Published in English and Chinese is Small, and the Development Trend is Slow

The annual volume of literature on the role of science teachers published in English and Chinese is shown in Figure 1. It can be seen from the figure that the study on the role of science teachers published in Chinese can be traced back to 2005 at the earliest. In the past 20 years, the study on the role of science teachers published in Chinese has been in the initial stage. The total number of papers published is not large, and most of them are descriptive research on the connotation and type of the role of science teachers. Especially when science education and science teachers receive special attention (to advance the strategy of “revitalizing the country through science education,” the Chinese Ministry of Education has issued a series of policy documents pertaining to science education. These include the Science Curriculum Standards for Compulsory Primary Schools, which were released in April. In May 2023, the MOE and eighteen other ministries issued the Opinions on Strengthening Primary and Secondary School Science Education in a New Era [2023], which provides researchers with opportunities to focus on science education in

China). The research on the role of science teachers has still not become a research hotspot.

The earliest study on the role of science teachers published in English can be traced back to 2002. Following the introduction of the Next Generation Science Standards in the United States in 2013, researchers began to examine the role of science teachers. For instance, one study sought to identify the essential competencies and responsibilities of science teachers (Bybee, 2014). However, in the past two decades, the overall research is still relatively small and the development is relatively slow.

Therefore, we can find that the study on the role of science teachers published in English and Chinese has shown a relatively flat state in the development trend. At present, the study published in English and Chinese has not taken it as a research focus and has not received due attention.

On the Main Themes of the Study Published in Chinese Focuses on Theoretical and Strategic Research and the Study Published in English Focuses on Empirical Research

On the basis of reading through the abstract, keywords, and even the full text of each article, this study extracts its corresponding topics and puts them into the research topic analysis coding framework, thus obtaining the distribution table of the research topics of the role of science teachers published in English and Chinese, as shown in Table 2. It should be noted that since some studies contain more than one topic, the total percentage of all topics will exceed 100%.

From the perspective of research topics, the connotation and types of the role of science teachers (32.43%) and the role transformation of science teachers (16.22%) are the most concerned topics of Chinese scholars. This is related to the development stage of the research on the role of science teachers in China. At present, the research on the role of science teachers in China is still in the stage of theoretical exploration. There is more attention to the descriptive research on the connotation and type of role as well as the specific problems such as role transformation in the actual teaching situation.

Table 2: Distribution of research topics on the role of science teachers published in English and Chinese

First dimension	Second dimension	Study published in Chinese		Study published in English	
		Number of articles	Percentage	Number of articles	Percentage
Role expectation of science teachers	Role expectation of science teachers	4	10.81	1	3.70
Role orientation of science teachers	The connotation and type of science teacher's role	12	32.43	10	37.04
	Role responsibilities and specifications	3	8.11	2	7.41
	Background and dilemma of role orientation	1	2.70	1	3.70
	Influencing factors of role positioning	2	5.41	1	3.70
	Role positioning strategy	4	10.81	1	3.70
Role identification of science teachers	Role identification of science teachers	1	2.70	2	7.41
Transformation of the role of science teachers	Change of the role of science teachers	6	16.22	1	3.70
	Role conflict and adjustment of science teachers	2	5.41	1	3.70
Role influence of science teachers	Role influence of science teachers	2	5.41	7	25.93

These studies are the basic research to further enrich the role of science teachers. At the same time, Chinese scholars also pay high attention to the role expectation (10.81%) and role positioning strategy (10.81%) of science teachers.

International scholars pay more attention to the research on the connotation and type of science teachers' role (37.04%) and the role influence of science teachers (25.93%). It can be seen that in the descriptive research on the connotation and types of the role of science teachers, the study published in English and Chinese shows a common tendency, which also shows that the research on the role of science teachers is at the stage of theoretical exploration. The difference is that international scholars also pay more attention to the role of science teachers, and generally use empirical research paradigms to study the role of science teachers. Through empirical data to verify the role of different science teacher roles in teaching situations, which play a direct role in promoting the landing and development of science teacher roles, and are a key issue and direction that follow-up researchers can learn from.

The "should be" Research Published in Chinese and the "Real" Research Published in English should be Combined and Form a Positive Interaction

Comparing the research progress of the role of science teachers published in English and Chinese, the study found that the study published in English and Chinese has localized research characteristics, and the research content is also relatively rich. However, compared with the study published in English, there is still room for reference and improvement in empirical research in China. For example, regarding the research on the impact of different roles of science teachers, international researchers, and research institutions have verified the significant impact of different teacher roles on the classroom and students through empirical research (Zhai and Tan, 2015a; 2015b). Of course, the theoretical and strategic research focused by Chinese research institutes also provides some reference for international research. For example, Xu

(2006), through in-depth exploration of the role of science teachers, analyzed that science teachers should play the role of "impartor and learner of scientific knowledge," "collaborator and guide of scientific inquiry," "organizer and evaluator of curriculum implementation," and "participant and researcher of curriculum design." The ten roles of "the user and developer of curriculum resources" provide a theoretical framework for the role types of science teachers. Through comparison, it can be found that Chinese research pays more attention to the "should" research of the role of science teachers, that is, what should the role of science teachers be? However, international studies pay more attention to the "real" research of the role of science teachers, that is, what is the role of science teachers at present? By comparing the study published in Chinese and English, and combining the characteristics of the research on the role of science teachers published in Chinese and English, this study enables the research on the role of science teachers to form a positive interaction between the "should" research on what knowledge, abilities, and qualities science teachers should have and the "real" research on what science teachers are really like and how they develop and grow up.

DISCUSSION AND IMPLICATIONS

The research on the role of science teachers is in urgent need of further development. From the perspective of the number of papers issued, the current research on the role of science teachers has shown a relatively slow state of development and has not received due attention. However, most of the mainstream research paradigms are still in the stage of theoretical exploration. It is urgent to shift the focus of the research topic from theoretical research to practical application, clarify the key issues of the role of science teachers, and provide reference for follow-up researchers. In the process of analyzing the empirical research review of the role of science teachers, this study obtained the following enlightenment:

First of all, pay attention to the research on the role expectation of science teachers. Under the dual pressure of current social

development and educational reform, the behavior patterns that the public, students, and teachers expect science teachers to display have changed in different educational links and situations. In the past, most of the research on the role of science teachers is based on the theoretical analysis of the individual abilities of science teachers, while ignoring the expectations of society and students on the role of teachers. Therefore, the role expectations of society, students, and teachers for science teachers should be comprehensively considered in the follow-up research.

Second, expand the research on the role orientation of science teachers. The research on the role orientation of teachers has always been a key research topic at home and abroad, but most of the research has carried out descriptive theoretical exploration of the connotation and types of roles from a certain perspective. On the specific issues such as how science teachers should carry out the role orientation and what factors still exist in the role orientation process, follow-up research needs to be further expanded to provide concrete and operational strategic suggestions.

Third, pay attention to the research on the role identity of science teachers. The number of research on the role of teachers is not small. However, as a relatively special group of teachers, the number of research on the role identity of science teachers is far from enough. Under the background that the whole world attaches importance to the cultivation of scientific talents, science teachers play a very important role in this process, but especially in the primary school stage, science teachers are faced with embarrassing situations such as class hours being occupied, role marginalization, and “adjunct teachers.” Therefore, it is particularly important to pay attention to the role identification of science teachers in the follow-up research.

Third, improve the research on the role transformation of science teachers. In the new educational situation, the role of teachers has changed a lot. There are relatively many macroscopic studies on the influencing factors and strategies of teachers’ role change in the existing research, and the process of teachers’ role change may have role conflicts and adjustment behavior should also be the focus of attention. In the follow-up study, we should further strengthen the micro-level of the role transformation of teachers.

Finally, strengthen the role influence of science teachers. In terms of the role of teachers, domestic and foreign research shows obvious differences. In China, we mainly derive the possible impact of different roles of science teachers through theoretical derivation, while in foreign countries, we mainly carry out empirical research on the effect of different roles of science teachers in specific teaching situations, which has important reference significance for the follow-up research on the role of science teachers.

The research on the role of science teachers is an important starting point for the development of science teachers. At this

stage, there are still practical problems of slow development and insufficient attention. Therefore, based on the role theoretical framework, this study systematically analyzes the status quo of the role of science teachers to provide reference for the follow-up research on the role of science teachers.

CONCLUSION

This study underscores the urgency of conducting a comprehensive review of the research landscape concerning the roles of science teachers. We compared research on the role of science teachers in both English and Chinese publications and came up with a series of illuminating conclusions. The study reveals that research advancements in understanding the roles of science teachers lag across both linguistic domains. This indicates a general lack of sufficient attention to this vital area. Secondly, the study establishes an analytical framework grounded in role theory, delineating five core research themes: expectations of science teachers, their role orientation, role identification, transformation of their roles, and the influence they wield. This framework furnishes a robust foundation for in-depth scrutiny of science teacher roles, highlighting the multi-dimensional nature of the study. It is noteworthy that Chinese literature tends to adopt an “should be” perspective, focusing on the definition and aspirations for science teacher roles. In contrast, English literature primarily concentrates on the “real” context, examining how science teachers’ roles manifest in real teaching scenarios and their authentic impact on student learning. This discrepancy suggests a complementary relationship between the theoretical explorations prevalent in Chinese literature and the empirical focus in English studies. The combination of these two approaches can lead to a more holistic comprehension of science teacher roles. Such integration offers evidence-based support for shaping science education policies and enhancing science pedagogical practices globally.

In conclusion, this study not only diagnoses the current state of scholarship but also charts a forward-looking trajectory for future inquiries into science teacher roles. The study’s advocacy for the integration of theoretical discourse with empirical research and facilitation of cross-cultural dialogues paves the way for a new epoch in the research of science teacher roles. This evolution is intended to align research more closely with the practical needs of education, thereby fostering the professional growth of science teachers worldwide.

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