

Research Status and Improvement Strategies of "Teaching Research and Reform" in Local Science and Technology Universities

—A Case Study of University of Shanghai for Science and Technology

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Abstract: Teaching research and reform is the core path to improve the quality of university education and adapt to national education strategies. Against the background of comprehensively advancing the construction of the "Great Ideological and Political Course" and promoting the modernization of higher education, it is of great significance to systematically analyze the achievements and characteristics of teaching research and reform in local science and engineering universities. This study takes the University of Shanghai for Science and Technology (USST) as a typical case, adopts the bibliometric method, and retrieves and screens 811 academic papers on teaching reform published by the university from 2021 to 2023 from CNKI and Wanfang Data Knowledge Service Platform as research samples. Using the SATI tool, a multi-dimensional analysis was conducted on the research hotspots, author cooperation, literature sources and development trends of these papers. The research finds that USST's teaching research and reform has formed a development model characterized by "quality-oriented, demand-driven, practice-rooted and multi-dimensional integration", with core research focusing on five themes: Curriculum Ideological and Political Education construction, innovation of the "Great Ideological and Political Course", new engineering disciplines construction, cultivation of new-type talents, and exploration of teaching modes. In the future, more attention should be paid on adhering to the quality-oriented strategy, breaking disciplinary barriers, and expanding inter-university cooperation.

1. Introduction

In the context of comprehensively advancing the modernization of national higher education and thoroughly implementing the fundamental task of "fostering virtue through education", teaching research and reform (hereinafter referred to as "teaching reform") has become a key focus for local science and engineering universities to improve educational quality, enhance talent training

capabilities, and serve national strategic needs. In recent years, Chinese universities have actively responded to national policy requirements, such as the Work Plan for Comprehensively Promoting the Construction of "Great Ideological and Political Course" and the Notice on the Comprehensive Implementation of School Aesthetic Education Infiltration Action, and have carried out in-depth and diverse teaching reform practices. As an important carrier of teaching reform achievements, academic papers can intuitively reflect the research focus, development trend, and practical effect of teaching reform in universities, making them an important object for systematically evaluating the level of teaching reform research.

Local science and engineering universities, as an important part of China's higher education system, shoulder the important mission of cultivating applied and innovative engineering and technical talents and supporting regional economic and social development. However, at present, there is a lack of systematic and in-depth research on the current status, characteristics, and development laws of teaching reform research in such universities. Most existing studies focus on micro-level analysis, such as the teaching reform of specific courses [1] the teaching reform of data structure experiments [2], and the systematic teaching reform and innovation of specific disciplines [3]. For the overall analysis of teaching reform papers, most are traditional research reviews [4][5], lacking systematic quantitative analysis [6]. In this context, taking a typical local science and engineering university as a case, conducting quantitative and qualitative analysis on its teaching reform-related papers, and clarifying the research hotspots, author cooperation characteristics, literature source quality, and development trends, is of great theoretical and practical significance.

Taking the University of Shanghai for Science and Technology (USST), a typical local science and engineering university with distinctive disciplinary characteristics and strong regional service capabilities, as the research object, this study selects 811 teaching reform-related journal papers published by USST from 2021 to 2023 as research samples. Using the bibliometric tool SATI, this study conducts multi-dimensional analysis on the research samples from the aspects of research hotspots, author collaboration, literature sources, and development trends.

The research aims to solve three research questions: first, to systematically clarify the current status and characteristics of teaching reform research in USST, including the core research themes, the construction of research teams, and the quality of paper publication; second, to explore the evolution law of teaching reform research in USST from 2021 to 2023, especially the changes in research focus and paper quality; third, to put forward targeted improvement suggestions based on the research findings, so as to provide reference for optimizing the direction of teaching reform research in USST and other local science and engineering universities, and promote the high-quality development of higher education teaching reform.

2. Data Collection and Analysis

This study selected two major Chinese databases, CNKI (China National Knowledge Infrastructure) and Wanfang Data Knowledge Service Platform, as the data sources to retrieve journal papers related to "teaching reform" published by University of Shanghai for Science and Technology (USST) from 2021 to 2023. A total of 1,645 initial retrieval results were obtained. After machine deduplication, 1,299 papers remained. Through manual exclusion by researchers and discussion within the research team, 811 papers were finally included in the analysis. The main screening steps of the teaching reform papers are as follows: (1) Determination of data sources: Two Chinese databases, CNKI and Wanfang Data Knowledge Service Platform, were selected; (2) Construction of search formula: Taking thematic words such as "education", "teaching reform", "education analysis", "curriculum", "curriculum construction", "teaching", "teaching research", "labor education", "aesthetic education", "practical teaching", "laboratory construction", "Curriculum Ideological and

Political Education", "curriculum reform", "engineering education certification", "talent training", "major construction", "major reform", "innovation and entrepreneurship", "top-notch innovative talents", "industry-education integration", "science-education integration", "online-offline blended teaching", "flipped classroom", "teaching evaluation", "teaching quality monitoring", "online teaching", "online teaching platform" and "teaching data" as keywords, combined with two restrictions: author's unit "University of Shanghai for Science and Technology" and publication time "2021-2023", a professional search formula was constructed; (3) Retrieval: The search formula was used to retrieve in the two platforms, and 1,645 Chinese journal papers were obtained; (4) Machine deduplication: The export formats of the two platforms were unified, and NoteExpress software was used for machine deduplication, resulting in 1,299 journal papers; (5) Manual screening: By reading the title, keywords, abstract and first author's unit, a manual exclusion list was formed. After discussion within the research team, papers that did not meet the requirements were excluded, and finally 811 journal papers were obtained.

The bibliometric tool SATI was used to analyze the 811 papers, and the research results were obtained.

3. Research Results

Among the 811 papers analyzed, 324 were published in 2021, accounting for 40% of the total; 248 in 2022, representing 31%; and 239 in 2023, making up 29%. While the number of publications has shown a year-on-year decline over the three-year period, the quality of these "teaching reform" papers has improved notably. High-quality papers in this field are primarily represented by those indexed in the CSSCI (Chinese Social Sciences Citation Index), compiled by the China Social Science Research Evaluation Center of Nanjing University, followed by those included in the "General Catalogue of Core Journals in Chinese" (PKU Core). Notably, CSSCI-indexed teaching reform papers accounted for 4.18% of the total annual publications in 2023—surpassing the 2.77% share recorded in 2021, despite 2021 having the highest overall publication volume. Similarly, PKU Core papers on teaching reform made up 8.37% of the 2023 total, up from 6.48% in 2021. Collectively, these figures demonstrate a steady improvement in the quality of teaching reform research (see Figure 1 for details).

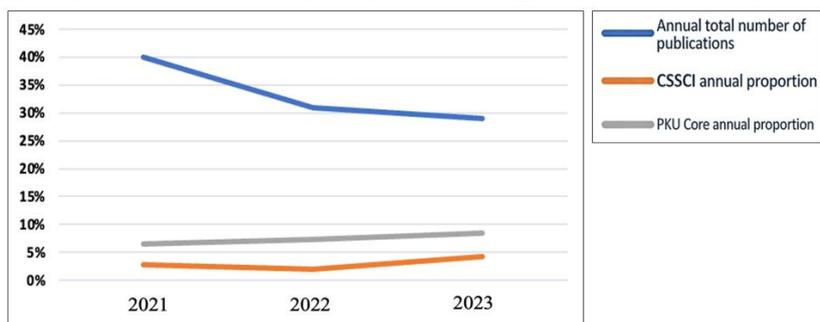


Figure 1: Trends in Total Number of Papers and Core Papers from 2021 to 2023.

3.1. Analysis of High-Frequency Keywords and Co-Occurrence Knowledge Graph

3.1.1. Analysis of High-Frequency Keywords

An analysis of the keywords from the 811 papers yielded a high-frequency keyword cloud map, where font size corresponds to keyword occurrence frequency—larger fonts indicate higher frequencies. The top-ranked high-frequency keywords include "Curriculum Ideological and Political Education", "teaching reform", "talent training", "ideological and political education", and "teaching

design".

Statistical analysis of keyword frequencies shows that "Curriculum Ideological and Political Education" is the most frequently occurring keyword in teaching reform papers, appearing 167 times, followed by "teaching reform" (70 occurrences, ranking second). Other high-frequency keywords include "talent training", "ideological and political education", "teaching design", "teaching mode", "experimental teaching", "new engineering disciplines", "teaching methods", "blended teaching", "artificial intelligence", "online teaching", "fostering virtue through education", "higher education", "flipped classroom", "virtual simulation", "practical teaching", "ideological and political elements", "case teaching", "aesthetic education", and "curriculum construction". In addition to single keyword frequency analysis, cluster analysis of keyword co-occurrence can further reveal the internal logical relationship between different research themes of teaching reform.

3.1.2. Keyword Co-Occurrence Knowledge Graph

Cluster analysis of high-frequency keywords yielded a keyword co-occurrence knowledge graph (see Figure 2). As can be seen from Figure 2, the teaching reform-related journal papers published by University of Shanghai for Science and Technology from 2021 to 2023 can be categorized into five main types:

(1) Construction of Ideological and Political Education in Courses. Research on the theme of "Construction of Ideological and Political Education in Courses" mainly revolves around the core keyword "Ideological and Political Education in Courses", with relevant keywords including "teaching reform", "curriculum teaching", "blended teaching", "process-oriented assessment", "teaching methods", "fostering virtue through education", "online education", "case teaching", "ideological and political teaching", "ideological and political elements", "curriculum construction", "teaching design", "Three Integrations and Three Approaches", and "all-round education for all students in an all-process manner". Based on the reading and analysis of the papers, it is found that "integrating ideological and political elements into classrooms" is a research hotspot under this theme. By focusing on three aspects—teaching reform, improvement of teaching design, and innovation of teaching methods—and combining the "Three Integrations and Three Approaches" paradigm as well as the requirements of all-round education for all students in an all-process manner, researchers aim to optimize the construction plan of Ideological and Political Education in Courses, improve teaching quality, and strive to integrate value guidance and virtue fostering into students' professional courses.

(2) Innovation of the "Great Ideological and Political Course". "What kind of people to cultivate, how to cultivate them, and for whom to cultivate them" are the fundamental issues of education, and the essence of education lies in fostering virtue through education. In line with the requirements of the CPC, the country, and the university, the teaching reform papers have actively carried out research on the innovation of the "Great Ideological and Political Course". Research on this theme mainly centers on the keyword "ideological and political education", with relevant keywords including "higher education", "practical path", "aesthetic education", and "artificial intelligence". Under this theme, scholars have conducted innovative studies on ideological and political teaching in higher education, such as the integration of artificial intelligence into college ideological and political education, the innovation of ideological and political education in the new era, and the theoretical exploration and practical construction of online ideological and political education. In addition, studies related to aesthetic education have been conducted, such as immersive red culture aesthetic education teaching in universities.

(3) Construction of New Engineering Disciplines. Against the backdrop of the new round of technological and industrial revolution and the transformation of knowledge production models, there is an urgent need to build and develop emerging engineering forms using new technologies, or transform and upgrade traditional engineering disciplines, so as to construct localized new

3.2. Analysis of Authors with High Publication Volume and Co-Occurrence Knowledge Graph

3.2.1. Analysis of Authors with High Publication Volume

From 2021 to 2023, a total of 1,247 authors were identified in the journal papers affiliated with University of Shanghai for Science and Technology, retrieved from CNKI (China National Knowledge Infrastructure) and Wanfang Database. Processing with bibliometric analysis tools yielded a cloud map of authors with high publication volume. Among them, the authors with the highest number of publications are Lu Lan (11 papers) and Qian Wei (11 papers). In addition, the top 10 authors by publication volume include Xu Fei (10 papers), Ye Tai (9 papers), Yang Hui (9 papers), Yan Feinan (8 papers), Cui Guomin (8 papers), Zhang Zhendong (8 papers), Zhu Wenbo (8 papers), and Wang Ning (8 papers). On the basis of clarifying the high-yield authors, further analysis of the author co-occurrence knowledge graph can help us understand the internal cooperation network of educational reform research.

3.2.2. Author Co-Occurrence Knowledge Graph

Cluster algorithm was used to analyze the relationships among authors, and an author co-occurrence knowledge graph was obtained (Figure 3). The analysis shows that the authors with the highest number of publications are Lu Lan from the School of Marxism and Qian Wei from the School of Mechanical Engineering. Lu Lan mostly published papers as the sole author, with no fixed collaborators and no close cooperative relationships. The authors closely cooperating with Qian Wei include Zhu Wenbo, Shen Wei, and Jiang Xiaohui; they have published papers together and form an educational reform research team in the School of Mechanical Engineering.

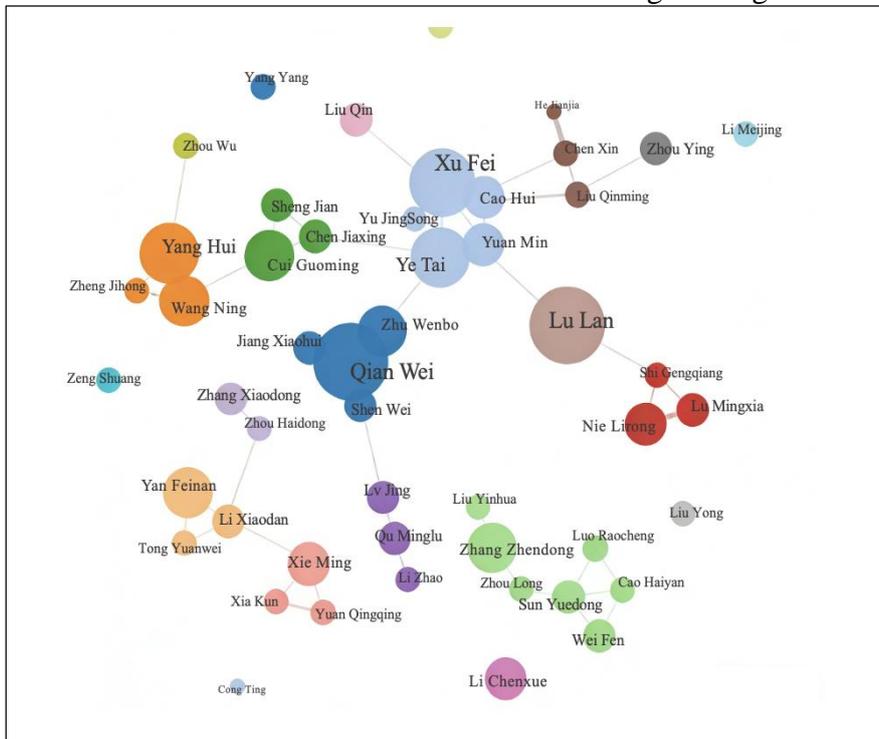


Figure 3: Author Co-Occurrence Knowledge Graph.

Ranking second in terms of publication volume is Xu Fei, who belongs to the School of Health Science and Engineering together with Ye Tai (ranking third in publication volume). They have a close cooperative relationship and form an educational reform research team in the School of Health

Science and Engineering with Yuan Min, Cao Hui, and Yu Jinsong from the same school. Another author ranking third in publication volume is Yang Hui, who has close cooperation with Wang Ning (ranking fourth in publication volume). Together with Zheng Jihong, they form an educational reform research team in the School of Optical-Electrical Information and Computer Engineering.

In addition, Yan Feinan, Li Xiaodan, and Tong Yuanwei from the School of Science form a research team. There are also Cui Guomin's research team from the School of Energy and Power Engineering (including Cui Guomin, Sheng Jian, and Chen Jiaying), the team of Xie Ming, Yuan Qingqing, and Xia Kun from the School of Mechanical Engineering, the team of Zhang Zhendong, Sun Yuedong, Wei Fen, Cao Haiyan, Zhou Long, and Liu Yinhua, the team of Nie Lirong, Lu Mingxia, and Shi Gengqiang from the School of Health Science and Engineering, the team of Liu Qinming, Chen Xin, and He Jianjia from the School of Management, as well as the research group of Zhang Xiaodong and Zhou Haidong from the School of Environment and Architecture.

3.3. Analysis of High-Frequency Literature Sources

From 2021 to 2023, researchers from University of Shanghai for Science and Technology published a total of 811 teaching reform-themed papers in 255 journals. Among the high-frequency journals, *The Guide of Science & Education* ranks first, with 82 papers on the theme of teaching research and reform of our university published over the three years. *Journal of University of Shanghai for Science and Technology* ranks second, with 63 relevant papers published. Journals ranking among the top 5 in terms of publication volume also include *Contemporary Educational research and Teaching Practice* (26 papers), *Education Modernization* (26 papers), *China Southern Agricultural Machinery* (20 papers), *Journal of Science and Education* (18 papers), *The Theory and Practice of Innovation and Entrepreneurship* (17 papers), and *Education and Teaching Forum* (17 papers). Among these journals, core journals represented by CSSCI and Peking University Core play a key role in reflecting the quality of teaching reform research results. The following will specifically analyze the publication status in core journals.

Among the 255 journals, 14 are CSSCI source journals, which published 24 educational reform papers over these three years, accounting for 2.96% of the total number of papers. These 14 journals are *Ideological and Theoretical Education*, *Technology Enhanced Foreign Language Education*, *Research in Higher Education of Engineering*, *Research in Educational Development*, *Journal of the Chinese Society of Education*, *Journal of National Academy of Education Administration*, *Social Sciences of Beijing*, *Editorial Friend*, *Science and Technology & Publishing*, *probe*, *Foreign Language Learning Theory and Practice*, *Academic Degrees & Graduate Education*, *Chinese Editors Journal*, and *China Publishing Journal*.

There are 35 Peking University Core Journals, which published 59 educational reform papers, accounting for 7.27% of the total. Among these 35 journals, the ones with the highest number of published papers include *View on Publishing* (6 papers), *Ideological and Theoretical Education* (5 papers), *Technology Enhance Foreign Language Education* (4 papers).

3.4. Analysis of Educational Reform Paper Trends

3.4.1. Analysis of High-Frequency Keyword Frequency Trends

Keyword frequency refers to the percentage of the number of occurrences of a term in a specific year to the total number of terms. An analysis of the frequency of each keyword from 2021 to 2023 shows that the frequency of papers on "Curriculum Ideological and Political Education" increased in 2022 compared with 2021, and remained almost the same in 2023 as in 2022. In addition, the changes of various high-frequency keywords over the three years were not significant, and the overall trend

was stable. It can be seen from this that the various modules of teaching reform research in University of Shanghai for Science and Technology have developed in a coordinated and comprehensive manner. Amid the overall stable trend, there are still individual high-frequency keywords that show a relatively increasing frequency trend over the three years, among which the most significant keyword is "new engineering disciplines". The frequency of the keyword "new engineering disciplines" increased significantly in 2023 compared with 2022; other keywords showing an increasing trend include "teaching methods" and "artificial intelligence".

3.4.2. Analysis of High-Frequency Author Frequency Trend

Statistical analysis of the publication frequency of high-frequency authors each year from 2021 to 2023 shows that the publication volume of each high-frequency author remained generally stable over the three years, with no significant fluctuations. In comparison, the publication volume of high-frequency author Cui Guomin showed an upward trend over the three years. In addition to Cui Guomin, other authors with an increasing publication trend include Lu Lan, Xu Fei, Ye Tai, Zhang Zhendong, and Cao Hui.

4. Conclusions

This study conducts a comprehensive bibliometric analysis of 811 educational reform-related papers published by University of Shanghai for Science and Technology (USST) from 2021 to 2023, covering research hotspots, author collaboration, literature sources, and development trends. The findings not only reveal the characteristics and evolution of USST's educational reform research over the three-year period but also provide valuable insights for optimizing the direction of educational reform research in science and engineering universities and promoting high-quality educational development. Specifically, the core findings are presented as follows.

From the perspective of research connotation, USST's educational reform research has formed a distinctive development pattern characterized by "quality-oriented, demand-driven, practice-rooted, and multi-dimensional integration". The core performance of this pattern lies in the shift from "pursuing quantity" to "prioritizing quality"—although the annual publication volume decreased slightly from 2021 to 2023, the proportion of core papers (CSSCI and Peking University Core) increased from 6.48% to 8.37%, and the number of papers published in university-designated Class A journals such as *Journal of University of Shanghai for Science and Technology (Social Sciences Edition)* continued to rise. This shift fully reflects that USST's researchers have gradually established a quality-oriented academic concept. Beyond the overall quality-oriented transformation, the research hotspots of USST's educational reform also show clear characteristics and laws.

In terms of research hotspots, the five core themes centered on "Curriculum Ideological and Political Education", "Innovation of the 'Great Ideological and Political Course'", "Construction of New Engineering Disciplines", "Cultivation of New-Type Talents", and "Reform of Teaching Modes" basically cover the core fields of higher education reform in science and engineering universities. Among them, "Curriculum Ideological and Political Education" has become the most prominent research hotspot, which is not only a response to the national requirement of "fostering virtue through education" but also an important exploration of integrating value guidance into professional education in science and engineering universities. The increasing frequency of keywords such as "new engineering disciplines" and "artificial intelligence" also indicates that USST's educational reform research has a strong sense of the times and forward-looking, closely following the development trend of technological revolution and industrial transformation, and striving to solve the practical problems of "how to cultivate high-quality talents adapting to the new era". While the research content and hotspots are constantly deepening, the research cooperation model and platform

construction, as important guarantees for research development, also deserve in-depth discussion.

From the perspective of research cooperation and platform construction, USST has initially formed a number of discipline-based teaching reform research teams. These team-based research models have laid a solid foundation for deepening teaching reform research. However, it is worth noting that the current cooperation model is mainly limited within colleges and departments, with insufficient cross-college and cross-regional cooperation. Most cooperative units are concentrated in Shanghai, and the breadth and depth of cooperation with universities in other regions need to be further expanded.

Based on the above conclusions, the following improvement strategies are put forward for the further development of USST's educational reform research: First, the University should adhere to the quality-oriented strategy, further strengthen the guidance and training of young teachers' core journal publication capabilities, and build a high-level academic exchange platform to promote the continuous improvement of the quality of educational reform papers. Second, the University need to break the barriers between colleges and disciplines, encourage cross-college and cross-disciplinary cooperation, and promote the integration and innovation of educational reform research in different fields. Third, researchers should expand the scope of inter-university cooperation, strengthen exchanges and cooperation with well-known domestic and foreign universities and research institutions, and absorb advanced educational concepts and research methods to broaden the research perspective. Fourth, research groups need to focus on the core demands of national strategic and regional economic and social development, further strengthen problem-oriented research, and enhance the practicality and pertinence of educational reform research, so as to provide more effective intellectual support for the high-quality development of university and higher education in China.

5. Research Limitations and Future Work

It should be emphasized that although this study has obtained valuable findings, it also has certain limitations. Specifically, the research is restricted by the research period, analytical methods, perspectives, and data sources, which may affect the comprehensiveness and universality of the conclusions.

First, the sample is limited to journal papers of USST from 2021 to 2023. The three-year period is relatively short, making it difficult to fully reflect the long-term evolution of teaching reform research. Second, the study mainly adopts bibliometric analysis, focusing on statistical indicators but lacking in-depth qualitative research on the core content and application effects of the papers. Third, the research perspective is relatively narrow, focusing only on a single university without horizontal comparison with other universities, so the advantages and characteristics of USST cannot be fully demonstrated. Fourth, the data only come from two Chinese databases, lacking foreign-language databases and other types of literature, which may lead to incomplete samples and potential bias. Based on the above limitations, further research will be carried out.

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