

Research Topics and Future Trends on Maker Education in China Based on Bibliometric Analysis

Qianfei Tian, Juan Zhang, Chuan Tang, Lina Wang, Junmin Fang, and Zhiqiang Zhang

Abstract—Maker spaces are expanding all over the world, with the development of modern information technologies such as cloud computing, big data, open source software, 3D printing, digital sensors, distant communication, etc. Meanwhile, maker spaces and modern information technologies are transforming education to form a networked, digitalized and characterized system. This paper retrieves maker education publications from China National Knowledge Infrastructure (CNKI) Database, presents core authors and institutions of maker education research in China through bibliometric analysis and visualization methods by Citespace V, reveals three research stages, and discusses future trends of maker education research in China.

Index Terms—Maker education, bibliometric analysis, Citespace V, China, CNKI.

I. INTRODUCTION

The rise of the maker movement is closely associated with the development of modern information technologies such as cloud computing, big data, open source software, 3D printing, digital sensors, distant communication, etc. In June 2014, the former U.S. President Obama hosted the first-ever White House Maker Faire and issued a call to action that “every company, every college, every community, every citizen joins us as we lift up makers and builders and doers across the country.” [1] In January 2015, China’s Premier Li Keqiang toured Shenzhen’s Chaihuo makerspace and declared makers “an inexhaustible engine for China’s future economic growth.” [2] In recent years, more and more makerspaces are set up all over the globe. By the end of March 2019, there are 2322 makerspaces listed in wiki.hackerspaces.org. [3] Fig. 1 demonstrates the distribution of the makerspaces in the world.

Maker education is an offshoot of the maker movement, which Time magazine described as “the umbrella term for independent innovators, designers and tinkerers”. Dale Dougherty, founder of the Maker Faire and Make magazine, stated in his 2011 TED Talk that “We are all makers. We are born makers. We don’t just live, but we make.” In the same

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TED Talk, Dougherty also called for making to be embraced in education, as students are the new generation of makers. [4]



Fig. 1. Distribution of 2322 makerspaces all over the world.

In order to have a basic understanding of maker education development and research in China, we retrieved published papers about maker education from China National Knowledge Infrastructure (CNKI). Bibliometric analysis and visualization methods are used to present the clear pictures. Main research topics and emerging trends on maker education in China are discussed.

II. DATA SOURCE AND VISUALIZATION TOOL

A. Data Source

China National Knowledge Infrastructure (CNKI) (Fig. 2) is the world’s largest Chinese journal full-text database, and has abundant literature resources as well as sound retrieval functions. [5] Using “maker education” as the subject words, 1976 papers were retrieved from CNKI on March 1st, 2019.

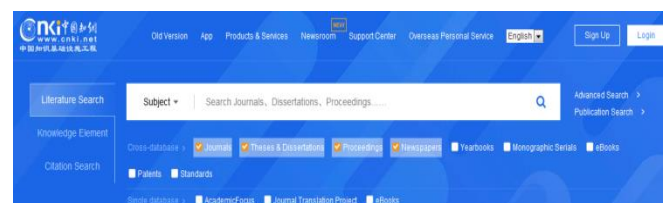


Fig. 2. Homepage of China national knowledge infrastructure.

B. Visualization Tool

CiteSpace (Fig. 3) is a freely available Java application for visualizing and analyzing trends and patterns in scientific literature. It is designed as a tool for progressive knowledge domain visualization. [6] It focuses on finding critical points

in the development of a field or a domain, especially intellectual turning points and pivotal points.

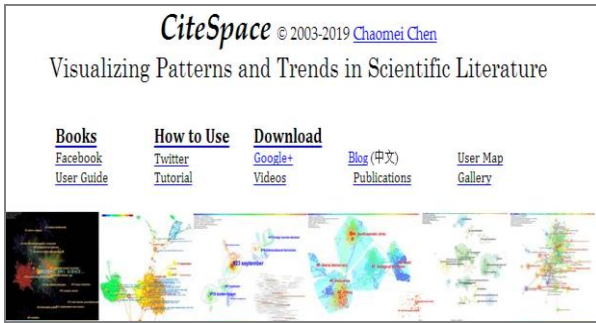


Fig. 3. Website of CiteSpace.

In this paper, we used CNKI database and Citespace V to visualize the yearly publication trend, core authors, core institutions and network, keywords distribution / network / clusters.

III. BIBLIOMETRIC ANALYSIS

Bibliometrics is statistical analysis of written publications, such as books or articles. [7] Bibliometric methods are frequently used in the field of library and information science, including scientometrics.

A. Number of Maker Education Publications

First 3 papers of maker education research in China published in the year of 2013. In the following years, the number of maker education publications increases heavily. CNKI database estimates the number would surge to 938 in 2019, shown in Fig. 4.

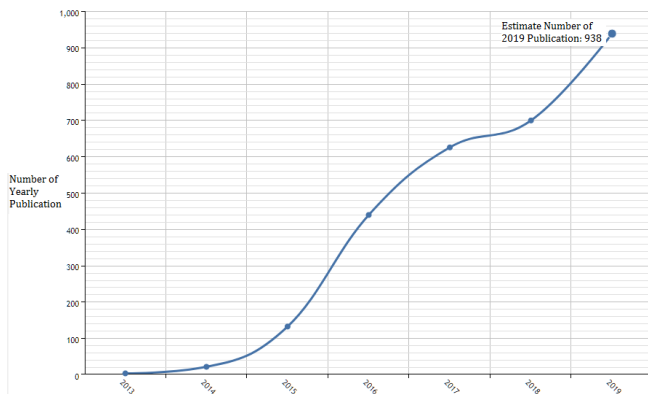


Fig. 4. Yearly publications of maker education research in CNKI.

B. Types of Maker Education Publications

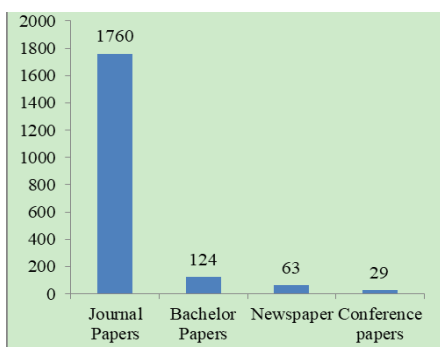


Fig. 5. Types of published papers.

As Fig. 5 shows, almost 90% maker education papers were published in journals, while some others were published in newspapers, conferences, etc.

C. Related Disciplines

More than 80% of the maker education publications focus in the subject of Education. The other crossing subjects include Library and information science, Business management, Computer, Languages, Business economy, Science of science and Sci-Tech management, Art, Ecology, and so on. Maker education research is crossing the borders of traditional education subject, and integrating into other domains. [8] (Fig. 6)

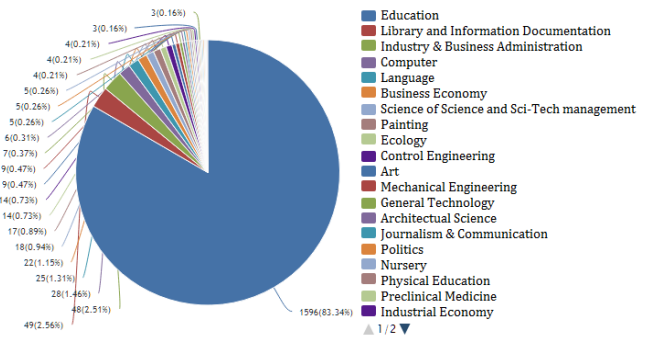


Fig. 6. Related disciplines of maker education research in CNKI.

D. Core Authors

There are 11 Authors who published more than 5 papers related to maker education in CNKI, as shown in Fig. 7. Xie Zuoru from Wenzhou Middle School in Zhejiang Province published 21 papers. Among his papers, *Differentiations of Maker Education and STEM Education* which was published in 2017, got the most citations (22) and downloads (963). The paper analyzed Maker Education and STEM Education from several aspects such as, their origin sources, contents, methods and essence. [9]

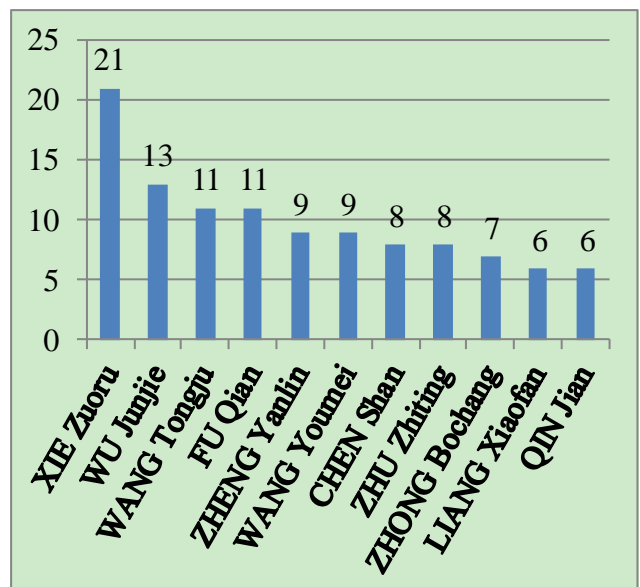


Fig. 7. Core authors of maker education research in CNKI.

One of Xie Zuoru's co-authors -- Wu Junjie from Beijing Jingshan School, published the second most maker education papers. Wu Junjie's most cited paper (citations 51) and most

downloaded paper (downloads 971) were both published in the year of 2014. The former publication mainly focused on “makers” and “future customers” in maker education [10]. The latter one introduced his/her own three years’ experience in “maker education” [11].

E. Core Institutions

Fig. 8 presents 10 institutions which published more than 15 papers related to maker education in CNKI. Among them, 7 institutions are normal universities, 1(Wenzhou universith) is a comprehensive university, 1(Wenzhou Middle School in Zhejiang Province) is a Middle school, and 1(Beijing Jingshan School) is a K-12 school.

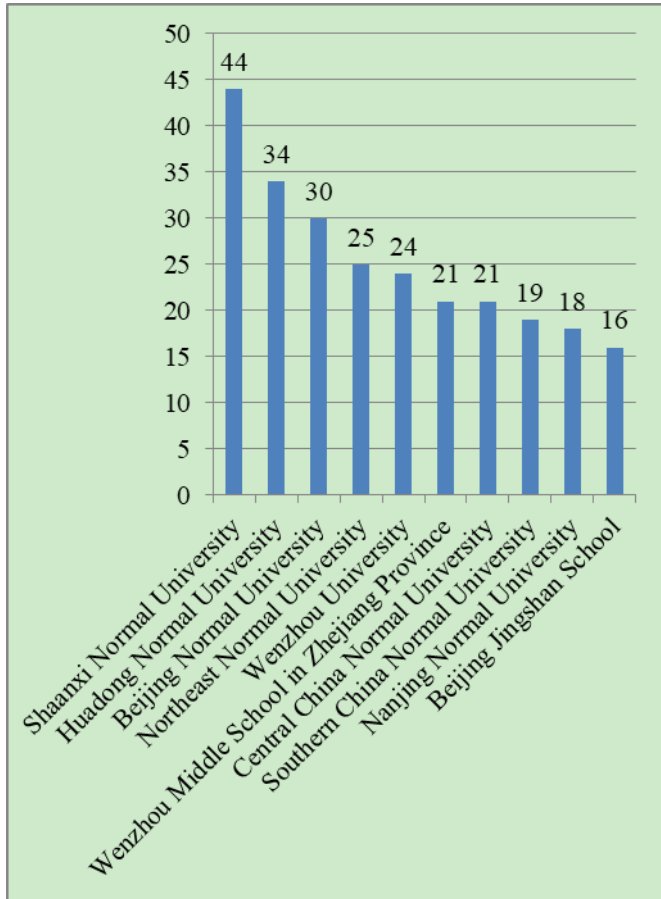


Fig. 8. Core institutions of maker education research in CNKI.



Fig. 9. Visualization of institution co-occurrence on maker education research in CNKI.

Fig. 9 visualizes institution co-occurrence. It shows 2 obvious clusters. The first cluster includes Wenzhou Middle School in Zhejiang Province, Beijing Jingshan School, etc. The second cluster includes Beijing Normal University, Nanjing Normal University, etc.

F. Keywords Distribution / Network

Based on Citespace V, keywords distribution and network visualization is presented in Table I and Fig. 10.

TABLE I: MAKER EDUCATION KEYWORDS AND FREQUENCY

No.	Keywords (Translated)	Keywords (in Chinese)	Frequency
1	Maker education	创客教育	1593
2	Maker	创客	257
3	Makerspace	创客空间	224
4	Maker movement	创客运动	62
5	Innovation	创新	54
6	Colleges and universities	高职院校	52
7	Primary and middle school	中小学	48
8	Teaching modes	教学模式	48
9	Innovation ability	创新能力	44
10	Maker culture	创客文化	43
11	Internet+	互联网+	41
12	Steam education	Steam教育	40
13	Information technology	信息技术	38
14	Innovation and entrepreneurship	创新创业	38
15	Universities	高校	38
16	Robots	机器人	33
17	Maker spirit	创客精神	31
18	Stem education	Stem教育	31
19	Maker Courses	创客课程	28
20	Innovation and entrepreneurship education	创新创业教育	28

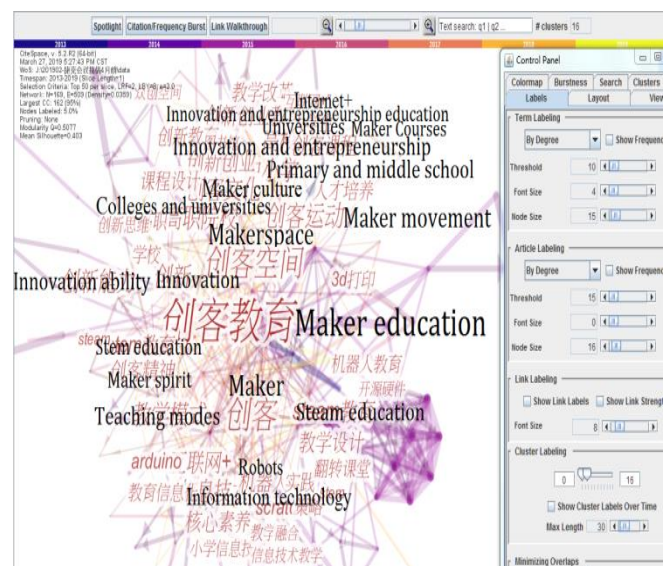


Fig. 10. Visualization of keyword co-occurrence on maker education research in CNKI.

According to Table I and Fig. 8, maker education research can be concluded into several topics. Such as, basic introduction and theory exploration on maker movement, maker space, and maker culture; difference and connection between maker education, STEM education and STEAM

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