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The Achievement, Limitation and Potential of Chinese Universities in STEM Fields: A Generational Perspective

Shen Wenqin

Shen Wenqin is Associate Professor of Higher Education at the Graduate School of Education, Peking University. He was a Visiting Scholar in the Department of Educational Policy Studies at UW-Madison in 2013 and 2014. He works in the field of sociology of higher education and history of higher education. His authored and co-authored publications focused on international academic mobility (especially the mobility of doctoral students and postdocs), doctoral career trajectories, transnational history of idea and practice of liberal education (China, UK and US).

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Introduction: Generational Differences and Higher Education

In the past four decades, Chinese universities have developed rapidly and their international rankings have been continuously improving, which has attracted great attention from the international academic community. There are many explanations for the rapid progress of Chinese universities, such as growing investment in scientific research, the Confucian cultural model (Marginson, 2011), national/global synergy (Marginson, 2018) and large-scale international academic mobility (Shen, 2020), etc. However, scholars also raised concern that the achievements of Chinese universities in the past 40 years can be viewed as limited. For example, in 2005, Qian Xuesen, Father of China's Missile and Space Program, told Chinese Premier Wen Jiabao that Chinese universities are unsuccessful in cultivating creative talents (Cao, 2014). Qian observed that none of the academic achievements by China's post-1949 graduates could be compared with those of their counterparts in the Republican era. This so-called "Qian Xuesen's Question" has become influential in the past 16 years in China. Qian's concerns are justified by the fact that, except for Tu Youyou, no scientist in mainland China has won the Nobel Prize so far.

Scholars further pointed out that the future development of Chinese universities faces many obstacles. They include, but are not limited to the authoritarian culture of Confucianism discouraging innovation (Poo, 2004); the toxic academic culture (Shi & Rao, 2010; Yang, 2015); the limited academic autonomy enjoyed by universities (Kirby, 2014); the insufficient protection of academic freedom (Altbach, 2009; Levin, 2010); and the restricted space for communication in the social environment outside the universities (Marginson, 2011). Undoubtedly, these discussions have provided meaningful insights for understanding the obstacles in the development of Chinese research universities; however, to better understand the formation of the development of Chinese research universities, it is necessary to consider it from a generational perspective.

The development of research universities depends on university academics of different generations, who were exposed to remarkably different educational and political environments. In a wider context, researchers in sociology have long noticed that the academic achievement of a scientist is not only influenced by personal factors, but also depends on the era in which s/he lives. Paula Stephan and Sharon Levin (1992) pointed out that lots of conditions of scientific achievements do not depend on individuals, but on the era. This means that the success of science depends in part on things that individual scientists cannot control (Stephan & Levin, 1992: 4); in addition, members of different generations will show differences in behavior, values, and intellectual abilities. (Stephan & Levin, 1992: 115). Hence, generational experiences and differences will inevitably have impacts on the development of research universities, which may lead to the formation of obstacles in the current development of Chinese research universities.

Within the higher education system, scholars of different age cohorts face different institutional environments, so the characteristics of their career development are also different. Since the 1980s, under the influence of neoliberalism and new managerialism, many countries have initiated reforms of the university personnel system. Reforms introduced from the outside have become an important factor in the division of scholars into separate generations. For example, there are three generations of scholars in Korea: the pre-

reform generation (senior scholars, hired from 1981 to 1990), the radical reform generation (the so-called sandwich generation, hired from 1991 to 2000) and the new generation (after the reform is institutionalized, that is, the generation hired after 2001). It was found that, compared to the senior generation, the new generation spends more time in management services and faces greater work pressure (Shin et al, 2015). In a transitional society like China, the issue of intergenerational differences is particularly prominent. In China, due to the "Reforming and Opening-up Policy" since 1978, the generation born before ("Pre-reform Generation") and after 1980 ("Post-reform Generation") faced many different social structures and opportunity structures (Lian, 2014). Compared to the pre-reform generation, the "Post-reform Generation" has different views on the state, business, and risk (Cherrington, 1997). Furthermore, a recent study found that among Chinese employees, employees born after 1990 show more individualistic cultural tendencies (Ma et al, 2016).

Existing studies have pointed out that in a transitional society, generational differences may have a significant impact on the higher education system. Taking Poland as an example, in 1989, it transformed from a communist country to a capitalist country. Since then, along with the political system changes, Polish higher education system has expanded rapidly, market principles began to enter the field of higher education, and the private higher education system developed rapidly. Against such background, scholars have been forced to compete for research funding and publish more international academic papers – this being an almost universal requirement for university faculty members (Kwiek, 2015). Young Polish scholars were facing fiercer competition, compared to previous generations (Kwiek, 2017). Kwiek's (2017) study also found that there are generational differences in Polish scholars' attitudes towards internationalization. Nevertheless, past analysis of scholars' generational differences has mainly focused on the influences of the political environment and the university system environment (such as academic evaluation system, teacher appointment system) on academic work and academic attitudes. In China's special environment, in addition to the above-mentioned factors, differences in the educational experience of scholars of varying age cohorts are also one of the causes of generational differences and conflicts. The generational differences seem most prominent in STEM Fields. The following section analyzes the impact of these differences on the development of STEM fields in Chinese universities.

Generational Differences and Chinese Academia in STEM

The Cultural Revolution that broke out in 1966 brought great damage to Chinese higher education. In the subsequent four years, Chinese universities stopped recruiting students. Many young people born between 1948 and 1957 lost the opportunity to receive higher education. They were called the lost generation (Hung & Chiu, 2003). In addition, scholars who received higher education before the Cultural Revolution also basically paused their scientific research during the Cultural Revolution. The talent gap caused by these events has had a profound negative impact on the development of higher education in China. After 1977, China's university research work, which had been suspended for many years, was restored, but the restoration process was slow, especially the process of integrating into the international academic community. In 1978, Chinese scholars published only 145 international papers indexed in Scopus (Zhong et al, 2019). American scholar Edward J. Kormondy visited China as a member of the American delegation in 1980. His report of the visit reveals that there were 2,700 teachers at Peking University, of which only 170 were full professors, and the average age of full professors was over 65. He regretfully pointed out that most of the teachers were not involved in research work at that time (Kormondy, 1982).

In the 1980s, the development of Chinese universities mainly relied on scholars born between the 1920s and 1940s. The scholars born in the 1940s who received higher education during the Cultural Revolution were

from a special group, called worker-peasant-soldier students. Except for a few, most of them had neither been through systematic scientific research training (Broaded, 1991), nor had received a doctoral degree. From 1981 to 1989, only 4,849 doctoral degrees were awarded in China. For instance, Xi'an Jiaotong University, a leading university at that time in China, awarded only 88 doctorate degrees in the 1980s (Zhang Wenxiu, 1990). Regretfully, there is a lack of data documenting the demographic characteristics of this group, but it is probably fair to say that many of these PhD holders are scholars born in the 1930s and 1940s. However, at that time, China's research in the field of STEM was already far behind that of the West. Even though Chinese scientists born in 1930s and 1940s could get the opportunity to receive doctoral education, this cohort of scholars could not get high-quality scientific research training. Furthermore, China's scientific research infrastructure was not able to support them to engage in world leading research after their PhD training. As a result, it was difficult for this generation of scholars to make world-class achievements in scientific research. At that time, some leaders of Chinese universities had a sober understanding of the situation. For instance, in a speech in 1985, Peking University's President Ding Shisun stated that the "great time of Chinese scholars born between 1930 and 1949 was wasted", most scientists of this cohort have not been engaged in scientific research for ten years or more, thereby resulting in their incapability to make edge-cutting scientific contributions. On the other hand, at that time, the Chinese government's investment in university research funding was insufficient, and laboratory conditions and scientific infrastructures were not good enough to support high-level scientific research. Hence, in Ding's opinion, the task of scholars of this generation was to "train the younger generation" (National Academy of Education Administration, 1986: 12).

In the early 1990s, many university teachers left the Chinese higher education system due to insufficient support for academic work and professional development. The Chinese government's investment in higher education in the 1980s was rather limited, and university teachers' wages were low, making it difficult to attract outstanding talents. In 1988, the monthly salary of associate professors at Peking University was only 150 RMB(Ding,1988). An academician in the field of communication engineering pointed out in an interview that, in the 1990s, retaining the outstanding doctoral graduates inside China was difficult, as many of them left and went abroad – a situation that only changed after mid-1990s.

In 1995, the government launched the "211 project" aimed at building a number of key disciplines in approximately 100 universities, and in 1998, the government launched the "985 Project" to build "world-class" universities. The launch of these two important projects was owning to the success of China's economic reform policies, the fiscal revenue of the Chinese government having reached a surplus in the early 1990s. After more than ten years since the launch of Project 211 and Project 985, the development of Chinese universities mainly relies on scholars born between the 1940s and 1960s. Among them, scholars born between 1959 and 1969 have better educational experience than the previous generation of scholars. Most of them have received complete primary and secondary education, as well as university education, and many of them have obtained doctoral degrees. In addition, thanks to the government's massive investment in promoting the internationalization of universities, many of this cohort of scholars have experiences in international research, and they have more international publications and international cooperation than the previous generation of scholars. Among the scientists born in the 1950s and 1960s, some scientists with global influence emerged, such as Tian Gang (1958), Xie Xiaoliang (1962), Shi Yigong (1967), E Weinan (1963), Rao Yi (1962), Deng Xingwang (1962), Xue Qikun (1962), etc. Similar list of scholars from 1950s and 1960s could also be found in the field of humanities and social sciences. It is under the leadership of these scholars born in the 1950s and 1960s that China's research universities have achieved rapid development in the 20+ years since the 1990s. The international rankings have been continuously improved, and the output of international papers has also rapidly jumped to the world leading position. However, the world-leading research results achieved by Chinese scholars born between 1950-1969 are still lagging behind those of their

counterparts in the West. As a top Chinese computer scientist, who was born in the mid-1950s, mentioned in an interview, there still exists a big developmental gap between the academic research in his field from China and that from Western countries. As of 2020, five Japanese scholars born between 1950-1969 have won the Nobel Prize. In contrast, Chinese scholars born in the same period have yet to achieve a breakthrough recognized by the Nobel Prize. In the STEM fields, scholars in China born between 1950-1969 are basically no longer in their most productive period for scientific research. As the interviewed top Chinese computer scientist claimed, "our generation's mission is to bring young people up." He believes that the future of China's scientific research will largely depend on scientists born after 1970.

Today, Chinese scholars born in the 1970s and 1980s are gradually becoming the main force of scientific research in Chinese universities. Even scholars born in the 1990s have begun to join the faculty of Chinese universities. Compared with scholars born before, they had a better educational environment at the K-12 education stage, and most of them have received high-quality PhD training. Thanks to the substantial increase in the number of scholarships for learning abroad after 2007, many of them had 1-2 years' international experience, and many of them obtained PhD degrees abroad (Shen, 2018). With more systematic scientific research training and international experiences, Chinese scholars born after the 1970s also show stronger scientific research potential and higher productivity. In the eyes of some scholars, Chinese scholars born in the 1970s and 1980s are a generation that has the potential to lead the world's research frontiers in the future. The interviewed computer scientist noticed, "the generation of Chinese scholars in their 30s and 40s is quite strong (in terms of research capacity). They are basically at the same level as their foreign counterparts" (personal Interview with an academician in computer sciences, 2018). An interviewed young scholar born in the 1980s stated: "Japan can win the Nobel Prize every year because of the accumulation of scientific research in the previous 30 years. Their country strongly supported scientific research during difficult times. Our country's previous investment was insufficient. Now the government's investment in scientific research is tremendous. I think it is unlikely to produce nothing. The next 20 or 30 years will be the golden time for China's scientific development, and there will even be Nobel Prize recipients" (personal Interview with a young scholar at Peking University, 2020).

Uncertainties and Challenges in the Future

The previous sections of this essay suggest that Chinese under-performance in competition for Nobel Prizes is related to the qualities of education and research training obtained by the older generations. This hypothesis is driven by the argument that the failure to break through the ceiling in achieving world-class research outcomes is partly explained by generational differences shaped by historical circumstances, which had an impact on scientists' educational preparation, research training, chances to do research and research conditions. Specifically, Chinese scientists born around 1930-1959 encountered the impact of political campaigns, interruption of exchanges with Western academia, the suspension of university enrollment, and the tide of marketization. This has caused scientists born in this time period to experience deficiencies in scientific research training and scientific research conditions, as well as the lack of knowledge stimulation through international exchanges. This made the scientific research heights they could reach inevitably limited. However, as the Chinese government has increased its investment in research universities, Chinese scientists born after the 1970s have better scientific research conditions, and they have more potential to make substantial breakthroughs in scientific research. Thereby, a follow-up question arises: in the next two decades, can Chinese universities make good use of scholars born after the 1970s to narrow the gaps between Chinese and the world's academic centers, and even become one of the world's leading academic centers? The answer is uncertain, as the future development of Chinese universities still faces multiple challenges.

First of all, compared with older generations of scientists, Chinese scholars born after the 1970s, especially Chinese scholars who have obtained doctorates abroad (this group occupies a considerable proportion of faculty positions in top universities, such as Peking University and Tsinghua University), seem to be less affected by nationalism and patriotism, showing a stronger cosmopolitan orientation. Whether the best of these scholars can take root in China for a long time remains uncertain, when calls for nationalism and patriotism increase. The cases of Professor Yan Ning (born 1977) of Tsinghua University and Professor Xu Chenyang (born 1981) of Peking University returning to the United States after having worked in China are quite revealing.

Secondly, many of the newly hired teachers at China's top universities have obtained PhD degrees abroad. Among the newly hired teachers of Peking University from 2017 to 2020, the proportion of returned PhDs accounts for 60.54%. China's scientific research culture emphasizes relationships and social capital (Shi & Rao, 2010). Compared with local PhDs, the PhD returnees are disadvantaged in terms of accruing social capital in the domestic academic community – so they may fail in local competitions for resources. How to successfully integrate the returnees into the Chinese scientific research community and let them play a leading role is still a major challenge for the development of Chinese universities (Chen, 2016).

Finally, the current academic evaluation and talent policies may restrict the scientific research potential of young scholars in China. Although many colleges and universities advocate quality orientation in name, quantitative evaluation orientation still prevails in reality in the process of academic evaluation (Shen et al, 2021). Meanwhile, even well-trained young scholars face many difficulties in their professional development when they are required to produce world-leading research in an academic system which prioritizes support to a very small number of senior scholars who have made outstanding achievements. Given that the support lacks equity, it may be difficulty to expect major breakthrough research by most of the young scholars.

References:

Altbach, P. G. (2009). One-third of the globe: The future of higher education in China and India. Prospects, 39(1), 11-31.

Broaded, C. M. (1991). China's Lost Generation: The Status Degradation of an Educational Cohort. Journal of Contemporary Ethnography, 20(3), 352-379.

Cao, C. (2014). The universal values of science and China's Nobel Prize pursuit. Minerva, 52(2), 141-160.

Chen, Q. (2016). Globalization and transnational academic mobility: The experiences of Chinese academic returnees. Dordrecht: Springer.

Cherrington, R. (1997). Generational issues in China: A case study of the 1980s generation of young intellectuals. The British Journal of Sociology, 48(2), 302-320.

Ding Shisun. (1988). The question is where to put education (In Chinese). Qun Yan, (12):1.

Hung, E. P. & Chiu, S. W. (2003). The lost generation: Life course dynamics and xiagang in China. Modern China, 29(2), 204-236.

Kirby, W. C. (2012). The world of universities in modern China. International Briefs for Higher Education Leaders, 1, 4–5.

Kormondy, E. J. (1982). The People's Republic of CHINA Revitalizing an Educational System. Change: The Magazine of Higher Learning, 14(5), 32-37.

Kwiek M. (2015). Academic generations and academic work: patterns of attitudes, behaviors, and research productivity of Polish academics after 1989. Studies in Higher Education, 40(8), 1354-1376.

Kwiek, M. (2017). A generational divide in the academic profession: A mixed quantitative and qualitative approach to the Polish case. European Educational Research Journal, 16(5), 645-669.

Lian, H. (2014). The post-1980s generation in China: Exploring its theoretical underpinning. Journal of Youth Studies, 17(7), 965-981.

Ma, J., Hu, Z., & Gocłowska, M. A. (2016). Cultural orientation in China: Differences across five generations of employees. Social Behavior and Personality: An International Journal, 44(4), 529-540.

Marginson S. (2011). Higher education in East Asia and Singapore: Rise of the Confucian model. Higher Education, 61(5), 587-611.

Marginson, S. (2018). National/global synergy in the development of higher education and science in China since 1978. Frontiers of Education in China, 13(4), 486-512.

National Academy of Education Administration (Ed.) (1986). Discussion on teaching reform in higher education (In Chinese). Beijing: National Academy of Education Administration

Levin R C. (2010). Top of the class: the rise of Asia's Universities. Foreign Affairs, 89(3), 63-75.

Poo, M. M. (2004). Cultural reflections. Nature, 428, 204-205.

Shen, W. (2018). Transnational research training: Chinese visiting doctoral students overseas and their host supervisors. Higher Education Quarterly, 72(3), 224-236.

Shen W. (2020). International academic mobility and the rise of Chinese Universities- a historical reflection under the trend of anti-Globalization. (In Chinese). Peking University Educational review, 18(04), 47-70+186.

Shen W., Mao D., Lin Y. (2021) Measuring by numbers: bibliometric evaluation of faculty's research outputs and impact on academic life in China. In: Welch A., Li J. (eds.) Measuring Up in Higher Education. Palgrave Macmillan, Singapore.

Shi, Y. & Rao, Y. (2010). China's research culture. Science, 329(5996), 1128-1128.

Shin, J. C., Kim, Y., Lim, H., Shim, B., & Choi, Y. (2015). The 'sandwich generation' in Korean academe: between traditional academic authority and meritocratic culture. Studies in Higher Education, 40(8), 1406-1422.

Stephan, Paula E., and Sharon G. Levin. (1992). Striking the mother lode in science: The importance of age, place, and time. Oxford: Oxford University Press.

Yang, R. (2015). Reassessing China's higher education development: A focus on academic culture. Asia Pacific Education Review, 16(4), 527-535.

Zhang, W. (1990). Retrospect and reflection of the ten years of postgraduate education (In Chinese). Degrees and Postgraduate Education, 01, 1-3.

Zhong, Z., Liu, L., Coates, H., & Kuh, G. (2019). What the US (and rest of the world) should know about higher education in China. Change: The magazine of higher learning, 51(3), 8-20.

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