Research Paper

ROE

ECNU Review of Education
2019, Vol. 2(3) 297–310

DOI: 10.1177/2096531119878557
journals.sagepub.com/home/roe

SAGE ECNUP

Post-PISA Education Reforms in China: Policy Response Beyond the Digital Governance of PISA

Wenjie Yang
Institute of Schooling Reform and Development, East China Normal University

Guorui Fan
Institute of Education Governance, East China Normal University

Abstract

Purpose: This study analyzes the Programme for International Student Assessment (PISA) data, revealing that the test itself reflects China's educational problems as well as the resultant effect of digital governance. Examining the root cause of these problems, this study demonstrates that the education reforms implemented in response to the PISA have gone beyond digital governance.

Design/Approach/Methods: This study conducts a text analysis of materials related to China's education system, including PISA data and analytical reports published by the Organisation for Economic Co-operation and Development since 2009.

Findings: Reflected by PISA data, the main problems facing China's educational sector include the overburdening of students at school, emphasis on knowledge acquisition during the teaching process, and the prevalence of extracurricular tuition. The digital governance effect triggered by PISA is highly consistent with China's constant and excessive pursuit of efficiency, emphasis on scores, and the rate of students entering higher level schools. In the new era, China actively reflected on the disadvantages of digital governance before implementing a series of education reforms that go beyond it.

Corresponding author:
Guorui Fan, Institute of Education Governance, East China Normal University, 3663 N. Zhongshan Rd, Shanghai 200062, China.
Email: grfan@ecnu.edu.cn

Originality/Value: This study is based on China's cultural background and the latest contexts. It examines the impact of the large-scale international assessment on China's education governance and discusses the impact of digital governance on the education reforms in other countries. The implementation of China's post-PISA education reforms demonstrates that different countries can implement rational education reforms based on their own cultural traditions and social realities as well as by referencing and using PISA data with care and prudence.

Keywords

China, digital governance, education policy, education reforms, PISA

Date received: 10 July 2019; accepted: 6 September 2019

Background

Developed by the Organisation for Economic Co-operation and Development (OECD), the Programme for International Student Assessment (PISA) is an international test assessing the knowledge and skills that 15-year-old students should master in order to engage with society. The program has had a wide and profound impact on major countries around the world. With PISA's global influence, the OECD has become the "arbitrator of global education governance" (Meyer & Benavot, 2013, p. 9). The design concept of the PISA indicates that it connects various key factors to ensure comprehensive analysis, including students' test scores, their personal characteristics, and factors affecting learning within and outside schools. It identifies the differences between results of students from various backgrounds, schools, and education systems. It then determines the characteristics of the schools and education systems in which students achieve good results and which practice the equitable distribution of educational opportunities. Consequently, the assessment data can answer the following questions: "What policies are effective?" "Why are these policies effective?" and "What types of policy reforms may be the most effective?" (Lu, 2010).

In 2009, Shanghai represented China in participating in the PISA for the first time, emerging as the champion for 2 consecutive years. Represented by Shanghai, the Chinese education system has since replaced Finland as "the new cover poster for excellence" (Kamens, 2013, p. 131). China's growing educational achievements pose a challenge to the U.S., leading to a rivalry akin to when the Soviet Union launched the first artificial satellite during the space race of the 20th century (Dillon, 2010; Kristof, 2011). After the computer-based version of the PISA was launched in 2015, 540,000 fifteen-year-old students from 72 countries and regions participated, with students from Singapore achieving the best overall performance. The combined Chinese team from the four provinces/cities of Beijing–Shanghai–Jiangsu–Guangdong (B-S-J-G) dropped to the 10th position; more specifically, the Chinese team was ranked 10th for science, 27th for reading, and 6th for

mathematics. Although these results were significantly poorer than previous results, the Chinese team's performance kept the country in the top echelon of the 72 participating countries.

Digital governance (Lingard, 2011) is a common perspective used in contemporary education policymaking. This is because numbers have made comparisons the new form of governance model across countries and on the global scale (Nóvoa & Yariv-Mashal, 2003; Simola, 2005), and policies are used as leverage to influence the education reforms of various countries. The outstanding performance of Chinese students in mathematics, reading, and science has prompted many countries around the world to shift the focus of their education policy reform toward the East (Auld & Morris, 2014; Crossley, 2014; Waldow, 2012; You & Morris, 2016). Although countries such as Australia, the U.S., and the United Kingdom (UK) have prioritized China as the reference template for their school systems and national education reforms (Alexander, 2012; OECD, 2014b; Sellar & Lingard, 2013), few studies have considered China's views toward its PISA achievements.

The relevant literature has mainly (i) analyzed the rationality of China's education reforms by connecting PISA data with current education reforms (Tan, 2017; Zhang & Alexander, 2012), (ii) excessively mythologized the Chinese education system represented by Shanghai (Tan, 2013; Waldow, Takayama, & Sung, 2014), (iii) paid attention to media and policy discussions triggered by PISA, or (iv) focused on the responses of education decision-makers rather than the other stakeholders (Baird et al., 2016). There is a lack of overall analyses of the problems faced by China regarding the reforms of its education system as a result of digital governance triggered by PISA. This study systematically analyzes China's education problems as reflected by the PISA as well as the education reforms developed to address these issues. This study also addresses the impacts of the tendency toward digital education governance triggered by the PISA on China's education reforms in order to counter the future challenges of digital governance.

Mirror images: PISA and China's education issues

Students' performances in PISA are measured by their abilities to complete increasingly complex tasks. The test results are categorized into one of seven ascending levels from 1b to 6. Of these, Level 2 is the baseline and represents the minimum basic skills required to participate in social activities. Only students with scores at Levels 5 and 6 are considered the best in science, reading, or mathematics. Presenting results by ranking student scores, PISA reveals the weaknesses and blind spots in the education systems of various countries. Despite receiving good PISA results in the past, the unsuccessful performance of Shanghai students in more recent PISA has exposed the weakness of the municipal government's approach to education (Tan, 2017). As such, the superficial glory of China's PISA high rankings reflects some of the deeper issues within its current education system.

Table 1. Learning hours for relevant subjects in representative countries and regions according to PISA 2015.

	Hour per week				
Country & Region	Science	Math	Reading	Other subjects	Total time in school
Finland	3	1	2	15	24
Singapore	6	6	3	12	27
B-S-J-G	6	4	4	19	33
South Korea	3	4	3	22	31
OECD average	3.30	3.39	3.36	15.51	26.56

Source. Adapted from OECD (2016b).

Note. The weekly learning times for the various subjects in Finland, Singapore, B-S-J-G, and South Korea were estimated on the basis of the results of PISA2015. PISA = Programme for International Student Assessment; B-S-J-G = Beijing–Shanghai–Jiangsu–Guangdong; OECD = Organisation for Economic Co-operation and Development.

Overburdening of Students at Schools

The PISA 2012 report indicates that students in Shanghai spent more time on homework than their peers, spending approximately 13.8 hr a week on homework compared to the OECD average of 4.9 hr (OECD, 2014c). In 2015, PISA surveyed the students' average amount of time spent in class, total duration spent in classes per week, and the respective number of hours spent on science, reading, and mathematics. Table 1 presents a comparison of the weekly learning times of students from the top-ranking countries in PISA 2015.

Among OECD countries, students reported an average learning time of 26 hr and 56 min per week. The breakdown of hours per week for science, language learning, and mathematics courses was 3 hr and 30 min, 3 hr and 36 min, and 3 hr and 39 min, respectively (OECD, 2016b). On average, Finnish students spent approximately 24 hr a week learning in school, and their weekly learning times for the three subjects were the shortest. In contrast, students from China had the longest learning week among all countries participating in PISA 2015, averaging at 33 hr per week—approximately 9 hr longer than that of Finnish students and significantly higher than the OECD average.

Emphasis on knowledge transfer during the teaching process

The PISA 2000 results show that a small proportion of students who scored below Level 2 entered higher education, with the majority joining the low-wage labor market (OECD, 2016a). Taking the reading literacy test as an example, the PISA 2009 results show that nearly 20% of the participating Chinese students scored lower than Level 2, indicating that almost one fifth lacked basic reading skills. Students in this age-group who lack basic skills are likely to drop out of the education system

Table 2. Proportion of students at different reading levels in some countries and regions according to PISA 2015.

	Students sampled (%)							
Country & Region	Below Level 1b (<262)	Level 1b (262–335)	Level 1a (335–407)	Level 2 (407–480)	Level 3 (480–553)	Level 4 (553–626)	Level 5 (626–698)	Level 6 (>698)
B-S-J-G	2.1	6.2	13.5	20.9	25.4	20.9	9.1	1.8
Singapore	0.3	2.5	8.3	16.9	26.2	27.4	14.7	3.6
Canada	0.4	2.1	8.2	19.0	29.7	26.6	11.6	2.4
Finland	0.6	2.6	7.8	17.6	29.7	27.9	11.7	2.0
OECD average	1.3	5.2	13.6	23.2	27.9	20.5	7.2	1.1

Source. Adapted from OECD (2016a).

Note. PISA = Programme for International Student Assessment; B-S-J-G = Beijing–Shanghai–Jiangsu–Guangdong; OECD = Organisation for Economic Co-operation and Development.

without completing high school and end up joining the low-skilled workforce (OECD, 2010b). Table 2 shows the proportions of students at the different PISA 2015 reading levels. Compared to students from the top three countries—namely, Singapore, Canada, and Finland—a relatively high proportion (21.8%) of Chinese students did not attain the baseline score. This means that among the Chinese students tested, the reading literacy of approximately one in five failed to meet the minimum standard. Moreover, the proportion of Chinese students who scored below Levels 1b and 1a was as high as 8.3%. This figure is approximately 3 times that of the top three countries and 1.8% above the OECD average.

PISA 2012 tested students' creative problem-solving abilities. The results indicate that in China and other countries, approximately one in five students could only use traditional problem-solving methods, reflecting a lack of creative thinking ability (OECD, 2014b). While there are many reasons for this failure to cultivate creative thinking, the main reason may be that this capacity has not been effectively addressed through teaching and learning approaches in the classroom (Beghetto & Plucker, 2006, pp. 316–332). As a result of the impact and interference of evaluation indicators such as school performance, as well as teacher and student evaluations, Chinese teachers pay more attention to knowledge and rote learning in classroom teaching process. Moreover, knowledge-based learning oriented toward examination-based education is emphasized at the expense of training students' creative thinking and problem-solving abilities. The existing college entrance examination system has also been influential in this regard, with scores and ranking used as the bases for talent selection. Ultimately, students' abilities to think and learn have been stifled by factors at various levels, impacting the training of their thinking abilities.

An analysis of the proportion of Chinese students at the various PISA 2015 reading literacy levels reveals that their cognitive levels were average and below. While students had superficial abilities to read and comprehend text, they were unable to establish connections between different texts, explore the deeper connotations behind those texts, understand changes in levels when cognizing text, or demonstrate high cognitive levels. These results reflect China's teaching practices, namely "the students learn whatever the teacher teaches." Teachers predominantly focus on knowledge transfer and rote learning, emphasizing knowledge-based learning that is examination oriented and paying less attention to the cultivation of thinking abilities. Consequently, students may be able to understand the text literally but do not know how to answer questions using their life knowledge. The reading method at which Chinese students are most adept is summarizing the central ideas by segment—in other words, they generalize based on the segment's meaning. Chinese students are also good at understanding the general meaning of the entire text in chronological order and generally tend to have one reading style. Contextual analysis of text exposes their weaknesses in the mastery of knowledge and application ability. Reading has become merely a tool for learning and is not related to the improvement of comprehension abilities.

Prevalence of extracurricular tuition

In many countries, a significant proportion of students attend extracurricular tuition classes, especially in mathematics and language learning. Among OECD countries, 35%, 48%, and 41% of students attend such classes in science, mathematics, and language learning, respectively (OECD, 2016b). Chinese students also engage in a high rate of extracurricular tuition as a result of the demands for academic achievement and parental expectations. In 2014, 48.9–58.1% of elementary and 66.8–74.4% of middle school students in Shanghai attended extracurricular tuition. Meanwhile, in Beijing, 60.5% of elementary students in Grades 5–8 and 58.4% of middle school students engaged in extracurricular activity in 2015 (Li, 2019). Indeed, it is not uncommon for students to wake up at 7 a.m. and continue studying until past 10 p.m. in order to finish their homework (Tan, 2019).

The PISA 2009 survey shows that, although Shanghai students ranked first in reading, mathematics, and science, they spent 34.8 hr a week studying in and outside of class (OECD, 2010a). The PISA 2012 questionnaire reveals that the teaching time in Shanghai schools was roughly equivalent to that of other countries or regions. This means that students' academic burdens are mostly associated with after-school assignments. PISA data show that 15-year-old students in Shanghai spend an average of 13.8 hr a week completing assignments, with private tuition and remedial classes comprising an average of 3.3 hr per week. The total time spent on extracurricular learning per week amounts to 17.1 hr (OECD, 2014a). According to the PISA 2015 Survey, students spent an average of 3.2 hr on science, 3.8 hr on mathematics, 3.1 hr on language learning, 3.1 hr on

foreign language, and nearly 4 hr on other subjects (OECD, 2016b). Students in B-S-J-G (China) spent more than 25 hr a week learning after class, whereas students in Finland, Germany, Iceland, and Japan spent less than 15 hr per week on average.

Effects: PISA-triggered digital governance and the root cause of China's education issues

The PISA results are based on numbers, and its premise is to describe national school education systems and the "truth" of children's education. This way of thinking is used to distinguish and categorize countries on a global scale (Popkewitz, 2011, pp. 32–36). Although this approach of constructing and representing the world based on digital information seems objective and nonvalue laden, it obfuscates PISA's theoretical hypothesis (Poovey, 1998, p. 237). This approach has caused numerous countries to comprehensively reform their education systems in the hope of improving their rankings. As a result, such countries have focused on economic growth and pursued the utilitarian value of education, thus ignoring the intrinsic values of education, which is to educate people. More specifically, some countries have adopted the education policies of countries with good PISA performances in a bid to demonstrate the ranking and strength of their national education system at the global level, thereby elevating the international status of their system.

In the UK, the test results of British students were unsatisfactory following the implementation of PISA. Although the overall trend is stable, it has dips. When the PISA 2009 results were about to be released, the British government issued a white paper titled *the importance of teaching*, which proposed the importance of teacher quality to the overall quality of education (Department of Education, UK, 2010). Inspired by Shanghai's excellent performance in PISA, the UK's Department of Education launched the "England–Shanghai Mathematics Teacher Exchange Program"[1] in 2014. This program selected excellent math teachers for a study tour to Shanghai in order to understand the latter's advantages in (mathematics) education. Subsequently, *The Shanghai Maths Project*—a series of supplementary teaching materials in China—was introduced to British elementary and middle school curricula in the UK's strive to achieve good PISA results. Such rank-pursuing policies neglect the unique cultural, historical, and economic backgrounds of the country. This type of education reform is akin to impatiently taking shortcuts, only to receive adverse results: The learning burdens of teachers and students in the UK were increased, resulting in new educational problems.

PISA's narrative for the present and future is premised solely upon numbers. It describes the truth about education and social progress/regression based on "facts." In addition to PISA, numbers are an important part of contemporary societies (Popkewitz, 2011, p. 35). Studies have pointed out that the main reason for the overburdening of Chinese students is the expectations of parents and other educational stakeholders who insist on the college entrance examination constituting the

sole or main criterion for evaluating a school's quality (Tan, 2019). In fact, this evaluation system is merely symptomatic of a deeper lying issue. Examining the underlying cause, issues of comparative and digital forms of governance presented by PISA align with the country's ideas and practices regarding socioeconomic development and its pursuit of efficiency in education development. There are rational aspects to scores, rankings, and other quantifiable indicators, such as fairness—at least on the surface—and operational simplicity. For a long period of time, this tendency toward digitalization had a positive effect on educational development and benefited the promotion of educational equity. However, after an education system becomes sufficiently developed, it tends to obstruct scientific development (Ma, 2019).

During China's education reform, there was a period where the educational pursuit of "serving the development of socialism" echoed the economic development model, which centered on gross domestic product growth. These reforms promoted the development and progress of the Chinese society to some extent. The development method was based on the doctrine of efficiency, relied on scores as the single evaluation standard, and was represented by the lopsided pursuits of educational certificates and students' rates of entering higher level schools. The problems with this method became apparent when all levels and types of education started becoming fully popularized, and the overall quality level had generally improved. This led to the disorderly and uneven development of education, harmed students' physical and mental health, and violated the original intention of education reform.

Examples of negative aspects include the adoption of a cookie-cutter approach to evaluating students and schools, with scores constituting the only criteria used to determine merit; making entry to higher level schools the ultimate target of education to the detriment of other meaningful goals; using academic qualifications to determine an individual's career and prospects for promotion and evaluating graduates solely on their certificates; pegging job titles to the papers published and evaluating teachers quality based on authorship; and determining people's remunerations and assessing their talents according to superfluous accolades.

Going beyond: Practical explorations of China's education reforms

The PISA automatically collects and reproduces the educational information of various countries in a digitalized format and describes the results in the form of rankings. This has produced numerous negative effects. Although standardized testing has been used in many countries for decades, PISA has resulted in the extended application of this testing method and greatly exacerbated the reliance on such quantitative measures. For example, the U.S. recently used PISA as a primary indicator in the "Race to the Top" project. This has increased the use of standardized testing tools to assess the weight attributed to students, teachers, and education authorities. Characterized by the cyclical global test periods, the PISA describes the current status of education in

different countries by ranking, exacerbating the high pressures already faced by schools. This led to the appearance of more curricula that are formulaic and by the book as well as teachers who lack autonomy. Finally, by emphasizing a relatively small range of measurable factors in education, PISA diverts attention away from educational goals that are difficult or impossible to measure, such as physical, moral, civic, and artistic developments. PISA's method of measuring contents has limited people's visions of what education is and should be.

The best example of PISA results being utilized as a form of control is when analyses and interpretations of data and the factors affecting change are used to influence policy formulation. This has been described as a form of governance through data or indicators (Bogdandy & Goldmann, 2012). China has used the information provided by PISA to achieve two main objectives: (i) highlight Shanghai's existing educational problems in order to validate the need for reform and (ii) provide support for ongoing reform measures in order to redefine the goals and nature of education in Shanghai (Tan, 2019). Unlike many other countries obsessed with PISA rankings, even as China explores the reasons for its shortcomings in education, it is proactively improving the current situation through education reform while breaking through the shackles of digital governance. This is because the educational problems reflected by PISA are rooted in the fact that academic achievements are the only evaluation indicator, while the cultivation of students' abilities is ignored. In this regard, Shanghai drew upon PISA's advanced ideas, theories, and techniques of examination evaluation in developing its own "scientific assessment system" (Cao & Yan, 2014). In March 2011, the city gradually formed a set of green indicators for the comprehensive evaluation of academic quality. The set of indicators considers 10 different aspects: students' academic level, learning motivation, academic burden, teacher–student relationship, teaching methods, the principal's curriculum leadership, the impact of students' socioeconomic backgrounds on their academic achievements, students' moral conduct and behavior, students' physical and mental health, and student progress across multiple years.

Following the implementation of the green indicators, education management analyzed the evaluation results to comprehensively understand the students' academic situation at the regional and school levels, discover the effective experiences and shortcomings of education and teaching, explore the factors impacting scores, as well as guide schools to further understand the connotations of the green indicators in order to change teaching methods and optimize teaching behaviors. In regard to teaching research, the evaluation reports are interpreted and the evaluation information subjected to in-depth analysis, thereby providing schools and teachers with specific, detailed, and targeted teaching recommendations. For teaching in schools, the evaluation information is applied to the next stage of teaching improvement, thus forming a virtuous cycle of "standards → teaching → evaluation → improvement" that gradually forms a school-based guarantee system for education quality. The application of green indicators is based on the evaluation of multiple indicators

related to students and relevant stakeholders. It goes beyond the previous singular evaluation criteria of students' academic achievement and rates of entering higher level schools, thereby realizing the innovation of educational evaluation methods.

The next step is to find ways to integrate the evaluation concepts and methods of the green indicators into (i) the local education system for administrative decision-making, teaching, and research; (ii) the daily academic tests and reforms of the entrance examinations for senior high schools and colleges; (iii) assessment of schools' development; (iv) monitoring and supervision of the developmental status of government education; and (v) realizing the reform of the entire education evaluation system by learning from Shanghai's experience. These are all green indicator-related application problems awaiting solutions. Moreover, the indicators for physical and mental health, as well as moral conduct and behavior, are insufficiently developed in terms of content and evaluation methods, necessitating further and in-depth research.

While facing the fact that the performance of Chinese students in PISA 2015 was worse, it should be noted that this ranking does not represent the country's educational level as a whole nor does it imply that the standard of Chinese education has declined. On the contrary, China has gradually moved beyond the use of PISA's digital governance as an education policy tool. Instead, the PISA is combined with the country's current economic, cultural, and historical background. The internal and external environments of the education system constitute the bases from which to review and reflect upon current education problems, and the transformation of education governance is promoted through internal and external educational innovations.

Conclusion

In the global economic system, the educational success of a country or economy is not only an indicator that national standards have been achieved but also an indicator of an education system with the best performance and most rapid improvements (OECD, 2014b). PISA plays an increasingly significant role in global education governance. This is commonly attributed to three factors: (i) its acceptance as a universal measure of education quality, (ii) its perceived economic significance, and (iii) the promise of policy solutions to educational problems in the form of prescriptions of "best practices" (Grey & Morris, 2018).

The response of China to the disappointing PISA performance of Shanghai's students was reflective, measurable, and self-critical. The students' performance only related to a narrow definition of success and did not represent the current state of the entire education system in China (Tan, 2017). Through quantification, simplification, and measurability, PISA has demonstrated that its statistical inference represents the traditional partial construction of complex, complicated, and varied contexts, while reflecting the objective facts of education "performance." PISA has created a global domain for education policies through digitalization and statistical data. Although

PISA researchers have warned policy makers against focusing on rankings, it is easy and convenient for decision-makers to use the numbers and tables provided by PISA when formulating policies (Therese & Kristine, 2017). With the gradual rise of new technologies such as cloud computing and big data, the informatization process of human societies has gradually moved from the eras of computers and the Internet to that of big data. From small to massive amounts of big data, and the basis for education decision-making moving from experiences to digits, data are being used to "speak." Data are also being categorized and transformed into the basis for policies. To a certain extent, policy concepts based on evidence realize the substantive connection between microscopic data and macroeconomic policies. In terms of real significance, big data have become a policy concept for practical operations (Chen, Meng, & Zhang, 2014). Education governance based on big data is the inevitable result of the development trends in information technology. Even as the modernization of the education governance system is being promoted, education governance itself relies on numbers for characterization and encompasses an inherent tendency for digitalization. In doing so, the ways of governance based on ranking and results are further entrenched.

As an evaluation system, PISA should not become the driving force for countries to compete against one another for achievements and rankings. Instead, the role of PISA should be more like that of a mirror—a means by which a country can better understand the existing problems of its own education system through comparisons with other countries or regions. The advantages and innovations in the educational field demonstrated by high-performance countries can also be used as references to further enhance educational possibilities and experience. The PISA results are no longer the targets of various countries but an important frame of reference for the reform of their education systems and education policies. Going forward, the common trend of global education governance should be moving beyond global education quality assessments characterized by numbers. To this end, countries must hold the prudent view of PISA and transcend PISA-trigged digital governance. The combined efforts and long-term commitment of all countries are needed to address and solve the global governance problem caused by data.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The Major Project (Education) of the National Social Science Foundation of China in 2016 "Research on Modernization Strategy of Educational Governance System and Governance Capacity in China" (No. VGA160003).

Note

1. The mutual education and training exchange program between math teachers from the UK and China (Shanghai) was jointly led by China's Ministry of Education and the UK's Department of Education and jointly implemented by the Shanghai Municipal Education Commission, Shanghai Normal University, and UK's National Centre for Excellence in the Teaching of Mathematics. It is one of the key projects under the high-level Sino–British humanities exchange mechanism. The UK sent its outstanding teachers to learn, study, and receive training in China, while Chinese teachers were invited to teach in the UK and share their knowledge and experiences (Department for Education, UK, 2015).

References

Alexander, R. (2012). Moral panic, miracle cures and educational policy: What can we really learn from international comparison? *Scottish Educational Review*, *44*, 4–21.

Auld, E., & Morris, P. (2014). Comparative education, the 'New Paradigm' and policy borrowing: Constructing knowledge for education reform. *Comparative Education*, *50*, 129–155.

Baird, J.-A., Johnson, S., Hopfenbeck, T. N., Isaacs, T., Sprague, T., Stobart, G., & Yu, G. (2016). On the supranational spell of PISA in policy. *Educational Research*, *58*, 121–138.

Beghetto, R. A., & Plucker, J. A. (2006). The relationship among schooling, learning, and creativity: "All roads lead to creativity" or "you can't get there from here?" In J. C. Kaufman & J. Bear (Eds.), *Creativity and reason in cognitive development* (316–332). Cambridge, England: Cambridge University Press.

Bogdandy, A. V., & Goldmann, M. (2012). Taming and framing indicators: A legal reconstruction of the OECD's Program for International Student Assessment (PISA). In K. E. Davis, A. Fisher, B. Kingsbury, & S. E. Merry (Eds.), *Governance by indicators: Global power through quantification and rankings* (52–85). Oxford, England: Oxford University Press.

Cao, J., & Yan, W. (2014, February 8). PISA, Viewing basic education from a new perspective. *Guangming Daily*, *7* [in Chinese].

Chen, S., Meng, L., & Zhang, H. (2014). Evidence of education policy in the age of big data: Enlightenment of evidence-based concept on modernization of China's education governance and scientific decision-making. *Global Education*, *2*, 121–128 [in Chinese].

Crossley, M. (2014). Global league tables, big data and the international transfer of educational research modalities. *Comparative Education*, *50*, 15–26.

Department of Education, UK. (2010). *The importance of teaching: The schools white paper 2010*. London, England: TSO (The Stationary Office).

Department of Education, UK. (2015). Experts to visit Shanghai to raise UK mathsstandard. Retrieved from https://www.gov.uk/government/news/experts-to-visit-shanghai-to-raise-standards-in-math

Dillon, S. (2010). Top test scores from Shanghai stun educators. *The New York Times*. Retrieved from http://www.nytimes.com/2010/12/07/education/07education.html?pagewanted=all

Grey, S., & Morris, P. (2018). PISA: Multiple 'truths' and mediatized global governance. *Comparative Education*, *54*, 109–131.

Kamens, D. H. (2013). Globalization and the emergence of an audit culture: PISA and the search for 'best practices and magic bullets.' In H.-D. Meyer & A. Benavot (Eds.), *PISA, power and policy: The emergence of global educational governance* (pp. 117–140). Oxford, England: Symposium Books.

Kristof, N. (2011). China's education system. *The New York Times*. Retrieved January 15, 2011, from http://kristof.blogs.nytimes.com/tag/pisa-test/

Li, J. (2019). "Substitution" or "supplement"—Examining the quality of school education from the development of shadow education—An analysis based on PISA 2015 data of four provinces and cities in China. *Social Science of Beijing*, *5*, 57 [in Chinese].

Lingard, B. (2011). Policy as numbers: Accounting for educational research. *The Australian Educational Researcher*, *38*, 355–382.

Lu, J. (2010). Analysis of the policy guidance of PISA Research. *Research in Education Development*, *8*, 20 [in Chinese].

Ma, L. (2019, March 26). Replacing 5 single quantitative evaluation ways with comprehensive quality assessment. *Guangming Daily*, 13 [in Chinese].

Meyer, H.-D., & Benavot, A. (2013). Introduction. In H.-D. Meyer & A. Benavot (Eds.), *PISA, power and policy: The emergence of global educational governance* (pp. 7–26). Oxford, England: Symposium Books.

Nóvoa, A., & Yariv-Mashal, T. (2003). Comparative research in education: A mode of governance or a historical journey? *Comparative Education*, *39*, 423–438.

Organisation for Economic Co-operation and Development. (2010a). *PISA 2009 results: Executive summary*. Paris, France: Author. Retrieved from https://www.oecd.org/pisa/pisaproducts/46619703.pdf

Organisation for Economic Co-operation and Development. (2010b). *PISA 2009 results: Volume II, Overcoming social background: Equity in learning opportunities and outcomes*. Paris, France: Author.

Organisation for Economic Co-operation and Development. (2014a). *PISA 2012 results: Creative problem solving. Vol. V: Students' skills in tackling real-life problems*. Paris, France: Author.

Organisation for Economic Co-operation and Development. (2014b). *PISA 2012 results in focus: What 15-year-olds know and what they can do with what they know*. Paris, France: Author. Retrieved from https://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf

Organisation for Economic Co-operation and Development. (2014c). *PISA 2012 results: What students know and can do—Student performance in mathematics, reading and science* (Vol. *I*, Rev. ed.). Paris, France: Author.

Organisation for Economic Co-operation and Development. (2016a). *PISA 2015 results (Volume I): Excellence and equity in education*. Paris, France: Author.

Organisation for Economic Co-operation and Development. (2016b). *PISA 2015 results (Volume II): Policies and practices for successful schools*. Paris, France: Author.

Poovey, M. (1998). *A history of modern fact: Problems of knowledge in the sciences of wealth and society*. Chicago, IL: University of Chicago Press.

Popkewitz, T. (2011). PISA: Numbers, standardizing conduct, and the alchemy of school subjects. In M. A. Pereyra, H. G. Kotthoff, & R. Cowen (Eds.), *PISA under examination: Changing knowledge, changing tests, and changing schools* (pp. 31–46). Rotterdam, the Netherlands: Sense.

Sellar, S., & Lingard, B. (2013). Looking East: Shanghai, PISA 2009 and the reconstitution of reference societies in the global education policy field. *Comparative Education*, *49*, 464–485.

Simola, H. (2005). The Finnish miracle of PISA: Historical and sociological remarks on teaching and teacher education. *Comparative Education*, *41*, 455–470.

Tan, C. (2013). *Learning from Shanghai: Lessons on achieving educational success*. Dordrecht, the Netherlands: Springer.

Tan, C. (2017). Chinese responses to Shanghai's performance in PISA. *Comparative Education*, *53*, 209–223.

Tan, C. (2019). PISA and education reform in Shanghai. *Critical Studies in Education*, *60*, 391–406.

Therese, N. H., & Kristine, G. (2017). The politics of PISA: The media, policy and public responses in Norway and England. *European Journal of Education*, *52*, 192–205.

Waldow, F. (2012). Standardization and legitimacy: Two central concepts in research on education borrowing and lending. In G. Steiner-Khamsi & F. Waldow (Eds.), *World yearbook of education 2012: Policy borrowing and lending in education*. New York, NY: Routledge.

Waldow, F., Takayama, T., & Sung, Y.-K. (2014). Rethinking the pattern of external policy. Referencing: Media discourses over the 'Asian Tigers' PISA success in Australia, Germany and South Korea. *Comparative Education*, *50*, 302–321.

You, Y., & Morris, P. (2016). Imagining school autonomy in high-performing education systems: East Asia as a source of policy referencing in England. *Compare: A Journal of Comparative and International Education*, *46*, 882–905.

Zhang, C., & Alexander, A. (2012). PISA as a legitimacy tool during China's education reform: Case study of Shanghai (TranState Working Papers No. 166). Retrieved June 9, 2016, from http://econstor.eu/bitstream/10419/64810/1/727146068.pdf