American Journal of Business and Society
Vol. 5, No. 2, 2020, pp. 52-56
http://www.aiscience.org/journal/ajbs

Chinese Studies on PISA Mathematics Test in the Past Two Decades

Tianyu Li, Zezhong Yang*

The School of Mathematics and Statistics, Shandong Normal University, Jinan, China

Abstract

The PISA test focuses on the concept of lifelong learning and pays attention to the problem design of mathematical contextualization. With the increase in participating countries and regions, the PISA test system is also constantly developing and changing. Therefore, it is of great significance to study the PISA test. This article is to review the Chinese studies on the PISA, summarize the specific research aspects and achievements to put forward the prospect of future research. The results show that the domestic research on the PISA test itself is relatively small, but showing an increasing trend. Firstly, research focuses on values and the view of evaluation at the conceptual level, which embodies the characteristics of diversified literacy and instrumental cognition. Secondly, the research focuses on compiling the examination questions and comparative analysis of the PISA test questions with internal test questions and then applying research on two-bit cod. Third, research focuses on the overall development direction, content and contextualization of the PISA. Fourth, the research focuses on the neglect of cultural factors and the evaluation itself in the PISA. Suggestions: enhance the critical understanding of the PISA, we should not only blindly pursue it, but also realize that the PISA itself is not the perfect test. We should combine cultural factors and international perspectives, and we should not neglect its cultural characteristics and educational needs.

Keywords

PISA, Test Concept, Test Characteristics, Evaluation Framework

Received: January 16, 2020 / Accepted: February 19, 2020 / Published online: March 26, 2020

1. Introduction

Launched by the Organization for Economic Cooperation and Development (OECD) in 1997 and tested for the first time in 2000, PISA (Programme for International Student Assessment) is held every three year since then, with reading, mathematics, and science as core areas and one core area as the most focus of each test. Later, it continues to improve its evaluation system. For example, the PISA2012 included financial literacy in the evaluation system, the PISA2015 included cooperative problem-solving in the evaluation system, the PISA2018 included global competency in the evaluation system, and the PISA2021 included creative thinking in the evaluation system. Mathematics, which is the core area, has been the main area of assessment in 2003 and 2012. Furthermore, Mathematics will be the main evaluation area in 2021 which is the next year of testing. Therefore, mathematics plays an important role in the PISA, and the PISA test framework becomes closer to life and improvement. To better understanding，the concept of PISA test, absorbing and drawing on the experience of large-scale tests like the PISA, and avoiding misunderstanding, so the domestic research of the PISA needs to be reviewed.

The Chinese literature of CNKI was searched for the title "PISA" (till January 9, 2021), and 1,273 literature were obtained. After further searching for "PISA& mathematics", 255 articles were obtained. And the title search of "PISA&

* Corresponding author
E-mail address: zhongzee@163.com (Zezhong Yang)

mathematics" was followed by 164 literature. After excluding the interference in Leaning Tower of PISA in Italy and the literature with strong subjectivity and lack of empirical research, a total of 17 research articles in the PISA test itself were obtained.

Looking at these domestic research literature, the research on the PISA mainly focuses on four aspects: concept level, test question compile, development and problems existing in PISA. These aspects are explained one by one below.

2. Research on the Concept of PISA

At the conceptual level, the research can be divided into two aspects: values and evaluation. At the level of values, the PISA pursues the value concept of "diversified literacy" [1]. Pan Yong believed that PISA is different from "pure academic research". The PISA keeps an objective distance from social interests and the future destiny of mankind and highlights its distinctive forward-looking, developmental and strategic characteristics [2]. What the PISA expects and places on is not the present, but the literacy of 15-year-olds and their ability to face future life. The PISA is not the first test focusing on literacy, the comprehensive description of literacy is no longer limited to school knowledge and skills, but it provides various situations of student life. Lifelong learning breaks in the concept of "functionalism" and begins to attach importance to the application and controls of individual learning motivations, attitudes, and strategies. Wang ding believes that the PISA test embodies "big ideas or integrated concepts" [3]. In real life, there are often multiple mathematical topics involved in a situation. Therefore, the PISA focuses on comprehensively solving problems with real situations. Based on this, other scholars have also proposed that attention should be paid to the contextualization, mathematical process, problem analysis and problem expression [4], all of which are views under this value.

From the perspective of evaluation, li Yujia believed that the evaluation view of the PISA embodies the characteristics of Dewey's instrumental cognition characteristics [5]. In this view, truth is not absolute and preconceived. It can only be determined by success in practice. The PISA test selects the world-recognized teaching model and many emotional goals and dimensions at the school teacher level, and then further considers how to meet the scientific problems of design based on ensuring that these variables and latitudes are investigated. This avoids the problem that testing isn't scientific enough once there's a problem with the top-level designed theory. Unlike most domestic examinations, the direct purpose of the PISA evaluation is to improve the quality of education, optimize the quality of students, pay more attention to the above-mentioned quality of evaluation content and standards, and pay attention to the participation in learning. Therefore, non-disciplinary evaluation reflects the actual requirements of the social living environment on students [6].

3. Research on the Preparation of PISA Test Questions

On the research of PISA topics, the question research is the first aspect. Su Hongyu studied the process of weaving PISA test questions [7]. The specific process includes preparation, test question composition, cognitive interview, international test question composition, and pilot to test. The summary of the questions becomes a form similar to the question bank, which will be used in the test. At the same time, she also pointed out that the process is not linear, but often recycled. Secondly, researchers focus on the comparative analysis test questions. For example, Shenyang and others analyzed and compared Nanjing's middle school exam question with PISA test questions. The comparison found that PISA involves less knowledge, pays more attention to the investigation into the executive process of data statistics, and has more open questions. The further analysis of the number of open questions stems from the difficulty in judging the open questions about the middle school entrance examination, and the PISA test has strict cod for "all pairs, some pairs, no pairs" [8]. Once again, the study of cod, two-bit cod retains the very different responses and answers between cognitive processes and knowledge, so it is valued. Wang Lei and others analyzed the cod method of the PISA test [9]. In the PISA cod guide, the score of each question was determined using the method of score labels, code numbers, code descriptions, and basic examples. Then they further proposed to apply the two-bit cod method of the college entrance examination marking online, play the advantages of online marking, and achieve different provinces to set up a common response group to monitor the scoring quality. The other research is the analysis of the PISA test question types, such as Chen Jie, Qi Chunxia studied the types and characteristics of mathematical problems in the PISA test [10-11]. They found there are close and open questions on the structure, and the former is in the majority. The topic has the objective and subjective topic, and the former is a little more. In terms of context, the public and personal contexts related to life account for the most. In the interdisciplinary aspect, scientific mathematics is the most. Pure mathematics only accounts for 8%. On the characteristics, the practical situation, the multidisciplinary fusion, identifying the graph information and thinking ability are more valued.

4. Research on the Development of PISA

The research on the development of the PISA mainly focuses on the development process and new changes in PISA testing. On the one hand, it is the overall change trend of the test; on the other hand, it is the change of context and situation. In terms of the overall change, Ma Jiansheng and others have studied the changing trend of PISA [12]. The PISA is constantly expanding the test contents, such as increasing financial and economic literacy, problem-solving ability and global competence, increasing participating countries and regions. The number of participating countries and regions has reached 78 in the 2018 test. The PISA is increasing the explanatory power and constantly combining with breakthroughs in other disciplines to interpret the evaluation results. More than that, the PISA is also shifting from paper-based tests of the technology-based test. At the same time, the PISA is also changing from a paper-and-pencil test of a technology-based test, carrying out technology-based high-level capability assessment. For example, it is using human-computer interaction to test cooperative capabilities [13]. In terms of content and context changes, Dong Lianchun and others concluded that after analyzing the background that future social development requires a higher level of mathematical literacy for students. The implementation of the OECD education 2030 researched project and the long-term development goals of the OECD PISA assessment project. Both have promoted the OECD's revision of the connotation and evaluation framework of PISA2021 mathematical literacy [14]. Yu Guowen and others analyzed the evolution of mathematical content and context. And the content evolution shows a tendency to emphasize growth phenomenon, geometric approximation, computational simulation, and conditional decision making. but the changes in context were not obvious [15]. The evolution process also shows an important characteristic, that it pays more attention to the use of mathematics as a tool rather than a goal to train students to become 21st-century citizens that are ready for the future. Cao Yiming and others analyzed the "change and invariability" of the mathematical assessment framework and proposed that the main body of the PISA mathematical assessment framework, the connotation expression of mathematical literacy, and the adjustment of the structural system of the evaluation framework are changing [16]. The number of participating teams is increasing, the connotation expression is richer, and the structure is more prominent in mathematical reasoning. What has not changed is to continue to implement the content area based on the content of mathematical disciplines, pay attention to the real situation in the real world, and focus on the mathematical process that incorporates mathematical modeling ideas.

5. Research on Problems with PISA

Even though the PISA test is constantly developing and changing, there are still problems. The existing studies believe that the problems are mainly due to ignoring the influence of cultural factors and the mechanism of evaluation itself. In terms of culture, for example, Ma Jiansheng pointed out that while increasing the interpretation of the evaluation, the consideration of cultural factors was ignored in the test results. Other studies focus on the reverse study of the PISA performance of countries in East Asia and conclude that the Confucian cultural circle has an impact on the PISA test. For the evaluation itself, Lv Yunzhen analyzed the limitations of the PISA test of the methodological level [17]. The first is that the sample exclusion rate is too high. Although there are certain data limitation methods, the restrictions are not strict. In fact, when Shanghai participated in the PISA test of 2009, The secondary vocational students are excluded. Secondly, the target population is not representative of the whole country. For example, only some Chinese regions participate in the examination, the result cannot explain the situation of Chinese education. Thirdly, the student performance prediction model has inherent design misunderstandings. He thinks "Rasch Item Response Theory" needs prerequisites. One of the prerequisites is that "for all test populations, the PISA test project has an equal effect", meaning that people of different cultures can accept the PISA test questions. This is difficult to do. For example, Chinese students are not familiar with military spending. Finally, the "trend indicator" is misleading. Because the examination is held once every three years and the cores of different tests are different. The test questions vary greatly from two or more tests.

6. Discussion

Given the existing Chinese studies, the research on the PISA test itself mainly focuses on four parts: the concept of the PISA test, the analysis of the questions themselves, the development changes and the question of the examination itself. The analysis of ideas is more, but the main conclusions are to conclude. The analysis of test questions is the most popular research direction. Comparing and analyzing the similarities and differences between domestic tests and PISA tests. Using PISA tests questions to analyze, guide, and evaluate existing test questions. It has become a research hot point. There are few studies on the evolution of content, and some research will not appear until 2019. Furthermore, there are few doubts about the rationality and scientificity of the test method itself. Overall, there are few studies on PISA itself.

From the existing domestic research, there are two problems.

First of all, the research rarely considers the PISA test whether it is scientific and reasonable. In research, it is often assumed that the PISA test is "perfect", but this is not the case. The biggest challenge to international testing is that there are differences between different regions and cultures that interfere with the authenticity of the data. Even if the PISA test makes some measures, such as a large question bank, strict propositions, this cannot be completely trusted. In the comparative analysis of the PISA test questions and domestic test questions, there are often studying that default the PISA test question to be "correct", and we must learn from it in the preparation of test questions. Therefore, in terms of learning, we should analyze the PISA test in more depth, pay attention to cultural differences and learn from national conditions. For example, in the selective test, we can add open questions based on two-bit cod, and background factors should be added to the examination of regional education level.

Secondly, the understanding of the PISA test is only in the test itself, and it is not recognized that it is an external interference from the interference from international organizations. The Organization for Economic Cooperation and Development has demonstrated the need for urgent reform through the crisis. Then it shows the feasibility of reform through other efficient systems. But the trend and direction of a country's reform and development should be continuous and autonomous, and the most important it should meet the actual needs of the country, rather than "turn" under external rendering and publicity, which is a manifestation of the loss of sovereignty. There are few pieces of researches on PISA in China, but there is a lot of shallow applied researches. The data onto the PISA test is often regarded as "truth", which is thoughtless. Because the PISA does get some statistical data, but the improvement method and statistics itself causality is not strong enough. Just like a person does have leg pain, but the lesion may not be in the leg, may be caused by the compression of a nerve in the brain.

7. Conclusion

According to the above summary of domestic research, the following conclusions can be drawn:

(1) Domestic studies have a positive attitude to the multi-element culture values and instrumental evaluation concept of the PISA test. These ideas promote people to pay more attention to the needs of real-life and realize that the truth should be tested for practice. The concept of the PISA tests provides a foothold on lifelong learning. Lifelong learning should be maintained in the face of the needs of real-life and future life, and real-life testing can be used to meet this purpose more closely. Mathematics education is for the development of each student, it is to achieve different development for different students. It is not contradictory that we also need to enable students to adapt to future development and meet the needs of the labor market. So the idea of the PISA has been accepted.

(2) Domestic research shows interest in two-bit cod and attempts to introduce this method to improve domestic propositional methods. In domestic tests, especially in large-scale tests, the selection test is the mainstream. So ensuring the objective characteristics of them has become mathematics tests are as objective as possible. The answers are unique, although this doesn't conform to real life. The answers to subjective questions are not unique, which makes it difficult to achieve strict "fairness" in the judgment. Two-bit cod provides the possibility of change. Through two-bit cod, the subjective question scores are given quantitatively. Wang lei, Shenyang and others researched this cod method of the compilation of domestic questions.

(3) Chinese research pays attention to the development and existing problems of the PISA test and tries to achieve objective understanding. The PISA test is constantly developing, and the PISA2021 has undergone new changes. Researchers pay attention to the development of the content of the test and the development of the structural system. At the same time, it is also recognized that the PISA test pays more attention to the development level of education, while the domestic test pays more attention to the difference in selection. The PISA test itself also has the key problem of comparing students of different cultural foundations for an equal basis.

(4) There are many applications of PISA testing for domestic research, and there are few problems and development prospects for the testing itself. For the application of testing, it should be based on a deep understanding of testing. Internationally, due to the impact of the PISA test results, some countries, such as Finland, continue to maintain the stability of their education policies, and at the same time, they have made certain improvements [18]. Except for the difference that Japan has changed its education policy to meet the requirements of the PISA test [19]. Therefore, understanding the test itself is conducive to better comparative development.

References

[1] Xu, J. Z. (2012). "Literacy": The Pedagogical Position Behind the View of PISA Literacy. Foreign Primary and Secondary Education, (1): 17-23.

[2] Pan, Y. (2011). Enlightenment of PISA Values and Evaluation of Chinese Education Innovation. Zhejiang Education Science, (5): 3-7.

[3] Wang, D., & Li, B. M. (2017). Comparative Analysis of Times and PISA Mathematical Evaluation Analysis Framework. Global Education Outlook, (6): 20-34.

[4] Tong, Y. J. (2014). Enlightenment of PISA 2012 Mathematics Test on Cultivating Students' Mathematical Literacy. Middle School Mathematics Monthly, (5): 8-10, 17.

[5] Li, Y. J., Tang, H. F., & Meng, L. Q. (2019). Analysis of Effective Teaching Evaluation Thoughts in PISA2015 International Evaluation. Contemporary Educational Science, (9): 29-33.

[6] Wang, L., & Jing, A. L. (2013). What Have We Learned from PISA——A Study Based on the PISA China Test. Peking University Education Review, (1): 172-180.

[7] Su, H. Yu. (2008). PISA: The Design and Development Process of Mathematical Literacy Test Questions. Teaching and Management, (13): 49-51.

[8] Shen, Y. & Yu, P. (2017). Comparison and Thinking of PISA2012 and Chinese Mathematics Exams——Taking Nanjing Exam as an Example. Bulletin of Mathematics, (1): 6-8, 37.

[9] Lei, W., &Wei, W. (2016). Viewing the Online Scoring of College Entrance Examinations from the PISA Code. Educational Science Research, (4): 33-38, 45.

[10] Chen, J., Zhang, X., & Chen, S. R. (2017). Multi-perspective Classification Analysis and Inspiration Based on 50 PISA Mathematical Sample Questions. Junior High School Mathematics Teaching and Learning, (8): 39-41.

[11] Wu, C. X. (2009). Evaluation of PISA Mathematical Literacy and its Characteristics. Bulletin of Mathematics, (6): 40-44, 48.

[12] Ma, J. S., & Cai, J. (2019). Global Education Governance Penetration: The Purpose of OCED Education Policy: A Critical Analysis Based on the PISA Test Literature. Comparative Education Research, (2): 3-11.

[13] Yuan, J. L., & Liu, H. Y. (2016). The Experience and Trend of International Large-scale Education Evaluation——Taking PISA as an Example. Information Technology Education in Primary and Middle Schools, 20-23.

[14] Dong, L. C., Wu, L. B., & Wang, L. D. (2019). Review of PISA2021 Mathematical Literacy Evaluation Framework. Journal of Mathematical Education, (4): 6-11, 60.

[15] Yu, G. W., Chen, P. J., Feng, Q. L., Cao, Y. M. (2019). Evolution and Enlightenment of the Content and Context of PISA Mathematical Evaluation. Journal of Mathematics Education, (4): 17-23.

[16] Cao, Y. M., & Zhu, Z. M. (2019). Change and Invariance: Evolution of the Mathematical Evaluation Framework of PISA2000-2021. Journal of Mathematical Education, (4): 1-5.

[17] Lv, Y. Z. (2019). On the Misunderstanding of the Use of PISA Results at the Methodology Level. World Education Information, (4): 69-72.

[18] Yu, G. W., & Cao, Y. M. (2019). Finland: Insider Reflection on PISA Fever——Dialogue with Evaluation Team of Finnish Institute of Education. Foreign Primary and Secondary Education, (6): 1-9.

[19] Tan, J. C. (2014). What has PISA Changed? Japan's Education Reform from the Perspective of Academic Performance Evaluation. Journal of Teacher Education, 1 (5): 45-51.