STUDENTS' MATHEMATICAL PROBLEM POSING ABILITY IN CHINA: FROM HISTORY TO REALITY

[Muhui Li], [East China Normal University], [China]

[Binyan Xu], [East China Normal University], [China]

Abstract

Through the review of the connotation changes of "mathematical problem posing (MPP)" in the texts of mathematics curriculum in China from 1902 to 2018, this research finds that the development of the connotation of "MPP" and training requirements in China can be divided into three stages according to the content analysis. First, brewing in 1902-1977: a flash of light at teaching level; (2) exploring and growing in 1978-2000: goal-oriented vague guidance; (3) steadily rising in 2001-2018: top-down planning. Furthermore, the research evaluated students'problem posing ability by examining the quality of questions raised by students in different task situations. The actual response situation of the students is consistent with the setting of the task gradient basically, but the overall ability is lower than the expectation. It can be seen that the student have a lower starting point and relatively weaker ability in posing problems. The research also showed the differences in the performance of students' MPP ability, including regional differences and gender differences.

Introduction

This research reviewed the relevant statements of the MPP ability in the programmatic texts of the mathematics curriculum of elementary school and high school in China from 1902 to 2018. Combined with the mathematics learning status of the grade-8 students in China, this paper attempts to construct evaluation indicators and frameworks for students' MPP ability and to compare students' different performances and differences in MPP ability, obtaining evidence from practice.

Research questions

1.What evolution has the concepts and requests of "MPP" gone through in the texts of China's mathematics curriculum since 1902, and what are its characteristics?
2.How do Chinese grade-8 students perform in the assessment of MPP ability?

Research subjects

The research subjects in the first research question are the programmatic text of the mathematics curriculum in China from 1902 to 2018.

The research subjects in the second research question are the grade-8 students in China. The background information of the participants is as shown in Table 1.

Developed Area			Medium-developed Area		Underdeveloped Area			Total
B(4)	S(3)	G(3)	C(3)	D(3)	J(3)	Z(6)	X(1)	
174	121	80	153	114	145	247	176	1210

Tab.1 Research subjects (Question 2)

Note: The province/city codes are in alphabetical order, and the numbers in parentheses indicate the number of schools participating in the survey in their cities.

Research methods

Content analysis is the main research method for the first research question. The author designs a research thread of using content analysis to answer the first research question, including text screening, statistics coding, explanation and expression, interpretation of the development path and so on.

The research evaluates students' problem posing ability by examining the quality of questions raised by students in different levels tasks. The specific methods include the following steps. First, construct an evaluation framework of MPP ability based on literature analysis and expert discussion. Secondly, develop a measurement tool based on the framework. Thirdly, predict and adjust the test scale for the grade-8 students. Finally, code the formal test results to conduct quantitative statistical analysis and qualitative content analysis. The research analyzed the data in the following two aspects. First, the overall performance of the student's MPP ability, including the ability level distribution and the specific performance in tasks of different ability level. Second, the differences in the performance of students' MPP ability, including regional differences and gender differences.

Results

Results on conceptual development

From 1902 to 2018, the development of the connotation of "problem posing" and training requirements in China's mathematics syllabus or curriculum standards can be divided into three stages according to the frequency of keywords and the key points of expressions.

1. brewing in 1902-1977: a flash of light at teaching level;
2. exploring and growing in 1978-2000: goal-oriented vague guidance;
3. steadily rising in 2001-2018: top-down planning.

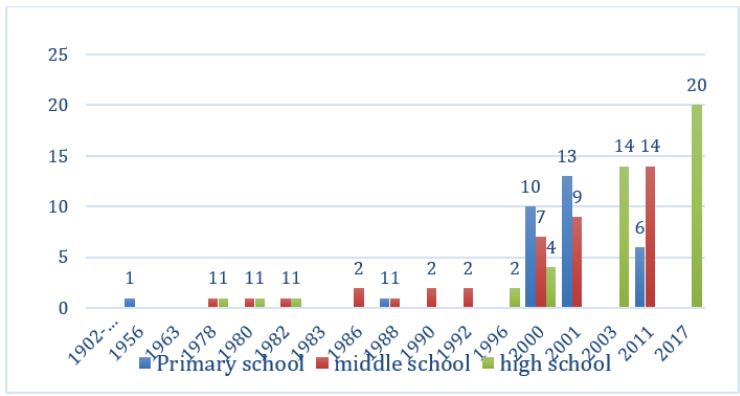

Fig.1 Expressions of problem-posing distributed over time and by schools

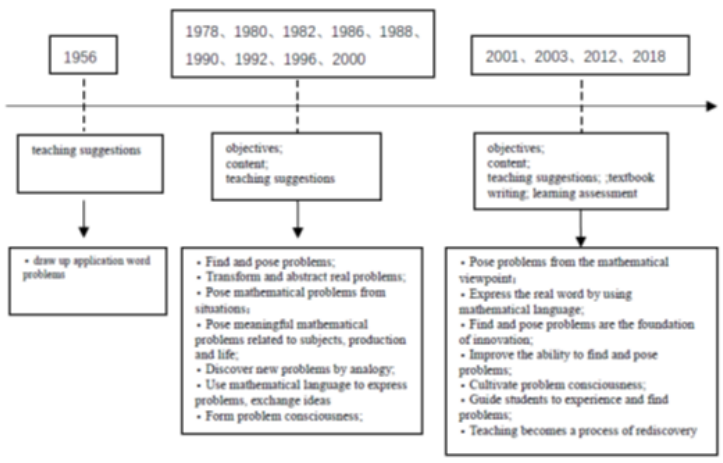

Fig.2 Development of specific expression of problem-posing

Results on empirical investigation

As the research showed, the test has obvious difficulty gradient, and the correct rate of students' answering decreases item by item. From the data, the actual response situation of the students is consistent with the setting of the task gradient basically, but the overall ability is lower than the expectation of the original level tasks. It can be seen that the student have a lower starting point and relatively weaker ability in posing problems, especially the number of students with high level MPP ability is too small.

	student number	Percentage
Level 1 all correct	587	48.5%
Level 2 all correct	262	21.7%
Level 1 all correct as condition, Level 2 all correct	172	14.2%
Level 3 all correct	94	7.8%
Level 1、2 all correct as condition, Level 3 all correct	27	2.2%

Tab.2 Students' correct rate in different task levels

The results indicate that students have the ability to create problem situations, especially life situations. The questioning environment that limits the situation would inhibit the passion of students' innovation. It is found that the mathematical problem with family life as the material and background accounts for a large proportion, followed by the school life as the background, and the social production or simple mathematical knowledge as the background is also involved, indicating different personal traits in students' contextual design. There are large differences between different provinces and cities in developed and medium-developed regions. This research also finds that the internal differences between provinces and cities in developed and medium-developed regions are more significant than that in less developed regions. Descriptive statistics show that there are 565 girls with an average score of 0.086, and 626 boys with an average score of -0.074. T test shows $T(1187)=3.693$, $p<0.001$, $d=0.214$ (effect value is small but meaningful), indicating there are significant differences in the general MPP ability of girls and boys, and that girls perform significantly better than boys.

Follow-up researches

This research will design some interviews to better understand the reasons why the connotation of the MPP ability in our curriculum standards can develop in this way and that why its requests change and develop. Simultaneously, this research will get to know that to what extent the current situation of Chinese students' MPP ability reflects the requirements of mathematics curriculum in China and its deficiencies, so that can reflect what needs to improve.

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