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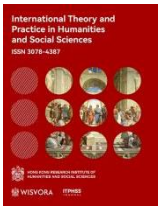

Analysis and Comparison of Function Concept Arrangement in Chinese, Singaporean and British Junior High School Mathematics Textbooks

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Abstract

A comparative study was used to analyse the Function Concept(FC) in the Chinese, Singaporean and British textbooks of junior high school mathematics, and it was found that the three textbooks were arranged vertically and horizontally: (1) in terms of the pre-preparation and post-extension of FC, the Chinese and Singaporean versions were similar, with rich and in-depth contents; (2) in the acquisition of the FC, the three were all arranged using the concept-formation method, with the Chinese textbook case scenarios are rich and hierarchical; (3) in terms of practice problems, Singaporean and British textbooks have far more than Chinese textbooks in both classroom and after-class practice, and the three have different levels and proportions in terms of the level of practice problems. Based on above, the following suggestions are made for the study of Chinese junior high school mathematics textbooks: (1) To consider using more universal pure mathematics contexts for the contexts in the textbooks; (2) To add “conceptual” and “conceptual understanding” practices to the classroom practice questions in the chapter of FC; (3) To provide students and teachers with a richer source of post-course exercises.

1. Introduction

The textbook is the primary vehicle for conveying the function content, thereby enabling students and teachers to explicitly delineate the course objectives and pedagogical content of FC in alignment with the prescribed curriculum standards. The extant research on FC in Chinese textbooks primarily concerns the content of knowledge points or practice problems, with the majority of studies concentrated in the high school level(GU et al., 2018). For example, A comprehensive comparative analysis(WANG et al., 2013) of the function content across five countries: China, the United States, France, Germany, and Japan. The analysis was based on the core concepts of high school mathematics. In the chapter on functions and mapping in high

school mathematics, there is a study (ZHANG & HU, 2013) that compares the contents of China and Australia. Furthermore, another study (CHEN, 2016) compares the level of problem contexts in functions between Chinese and American junior high school mathematics curricula. In conclusion, there is a paucity of research examining the overall characteristics of the textbook and exercise arrangement of function concepts in junior middle school mathematics. Accordingly, this paper presents a systematic comparison of Chinese, British, and Singaporean textbooks on the topic of FC in junior middle school mathematics, offering insights into global trends in textbook organization and problem design. The aim is to provide a reference point and stimulate ideas for the development of Chinese mathematics curricula.

RESEARCH QUESTIONS AND RESEARCH OBJECTIVES

Research Questions

(1) What's the differences of content and depth of different versions of the textbook in terms of their suitability for pre-preparation and subsequent extension of function concepts?

(2) What's the differences of number and difficulty of function concept acquisition, classroom and after-school practices in three versions of the textbook?

Research Objectives

(1) To evaluate the content and depth of different versions of the textbook in terms of their suitability for pre-preparation and subsequent extension of function concepts.

(2) To ascertain the differences in terms of the number and difficulty of function concept acquisition, classroom, and after-school practices in three versions of the textbook.

2. Literature Review

2.1 AHP Theory

The concept of function is a fundamental topic in Mathematics. (Mutambara et al., 2019) explore the understanding of the quadratic function concept among preservice teachers in Zimbabwe, using the APOS framework to investigate their conceptual understanding. (Pertiwi & Budiarto, 2020) conduct a study on the mathematical concepts found in Mlaten pottery, identifying various concepts such as the concept of a circle, geometry transformation, and the concept of function. (Hatisaru, 2020) focuses on secondary mathematics teachers' content knowledge for teaching the concept of function, examining both common and specialized content knowledge domains. (Sulastri et al., 2021) investigate prospective mathematics teachers' concept image of the limit of a function, utilizing a phenomenological approach to understand their understanding and the factors influencing it. These studies collectively highlight the significance of the function concept in various disciplines and the importance of understanding and teaching this fundamental concept.

Comparison research is a prevalent method used in various fields to analyse and contrast different aspects of a particular subject. The previous study (Chen et al., 2020) conducted a comparison research on mathematical knowledge for prospective teachers in Korea and China, specifically focusing on secondary mathematics teacher selection tests in both countries. Furthermore, other research (Arigo et al., 2020) adopted a scoping review on methods to assess social comparison processes within persons in daily life, emphasizing the importance of

naturalistic assessments of social comparisons. This review aimed to summarize existing literature on within-person naturalistic assessment of social comparison and provide key considerations for future research in this area. This study will start the research based on the comparison research.

The definition of a function is part of the curriculum devoted to the teaching of concepts. There are two basic methods of concept acquisition: concept formation and concept assimilation(SHAO & ZHANG, 2009; Tennyson, 1975). The process of concept formation entails the identification of key factors from a multitude of instances of a given phenomenon, thereby leading to the acquisition of a concept. In the process of concept assimilation, students employ their existing relevant knowledge to logically deduce new concepts. The two specific models of concept teaching are illustrated in Figure 1. This study seeks to find the differences among different versions of Mathematical textbooks in the part of concept acquisition.

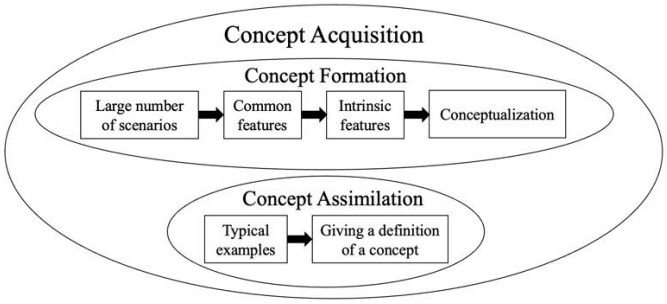

Figure 1: Two Basic Approaches to Concept Acquisition

3. Methodology and Procedures

3.1 Research Target

Because different publishers publish the same content, the content will be organized differently. Furthermore, schools also consider their own school situation when choosing textbooks. To identify the junior high mathematics textbooks used in this study, the following factors were considered: the scope of use of the textbooks, the time of publication and geographical factors. The results of this process are shown in Table 1 as shown below. The objects of study were selected from the following sections of the textbook: Chapter 4, Section 1 (Functions) of the Z edition; Chapter 12, Section 2 (Concepts of Functions) of the S edition; and Chapter 6, Section 1 (Finding Rules to Discover Functions) of the E edition.

Table 1: Sample Teaching Materials and Basic Information

Country	Sample teaching materials	Time of publication	Textbook code
China	Beijing Normal University Press: Compulsory Education Textbook Mathematics Grade 8	2013	Z
Singapore	Star Publishing: Discovering Mathematics-1B (2nd Edition)	2013	S
The United Kingdom	Oxford University Press: Cambridge IGCSE 5th Edition (Core)	2018	E

3.2 Framework of Analysis

The content arrangement analysis framework, as outlined by the research before (XU et al., 2021), employs a two-pronged approach to examine the textbook's content. The vertical analysis is concerned with the relevance of the content preceding and following the knowledge points within a given section. In contrast, the horizontal analysis examines the content arrangement of the knowledge points within the section itself.

In particular, the concept map(Schwendimann, 2023) is employed to examine the vertical coherence of the knowledge points preceding and following the focus on the definition of a function. Concept maps utilize elements such as nodes, connectives, links, propositions, and hierarchies to link related concepts, presenting both horizontal links between concepts and vertical lines of development. The concept map of functions was created using CmapTools software.

The horizontal analyses will investigate the methods by which the three versions of the textbook facilitate the acquisition of specific concepts. Furthermore, the analyses will examine the number of example exercise, example exercise perceptualisation, and practice questions for each of the acquisition steps in detail, based on the data presented in Figure 1. The case perceptibility, among other factors, is based on the scenario of the example, as illustrated in Table 2. Scenario 1 is derived from students' everyday experiences and is therefore straightforward and accessible. Scenario 2 is based on real-world context that demands students to demonstrate transfer and transformation abilities. Scenario 3 is an exercise in pure mathematical reasoning, which requires students to engage in sophisticated cognitive processes and to develop their critical thinking skills.

Table 2: Scenario Coding for Example Exercises

Encodings	Typology	Definition	Specificities
Scenario 1	Genuine situation	Real, non-perceived constructed situations such as everyday life, the real world, etc.	To help students learn abstract shapes from the foundation of image perception of shapes.
Scenario 2	Imaginary situation	Reality-based, artificially constructed situations	To facilitate students' discovery of mathematical knowledge embedded in contexts
Scenario 3	Purely mathematical situation	Purely mathematical symbols, graphs in context	To demand a high level of mathematical thinking

Furthermore, the number of practice questions was divided into two categories: those completed in the classroom and those completed outside of school. This allowed for a systematic comparison of the number of practice questions and the cognitive levels involved. In accordance with the preceding study(QIN, 2019), the cognitive levels of practice problems have been classified into four categories: Level 1 is conceptual, Level 2 is conceptual understanding, Level 3 is transferable understanding, and Level 4 is comprehensive inquiry. In conclusion, the Chinese Mathematics Curriculum Standards for Compulsory Education (2022 Edition) explicitly states that the mathematics curriculum should be dedicated to achieving the educational objectives of the compulsory education stage, be accessible to all students, and adapt to the individual development of students, ensuring that all individuals could receive a quality mathematics

education and that students can progress at their own pace in mathematics. Accordingly, a detailed comparison of the difficulty stratification of the practice questions was also conducted, with the stratification code presented in Table 3. A level is indicative of easy questions, B level of general questions, and C level of difficult questions.

Table 3: Hierarchical Coding of Practice Questions Difficulty

Layer	Z Edition	S Edition	E Edition
A	Knowledge and skills	Level 1	Exercise 1
B	mathematical understanding	Level 2	Exercise 2
C	Exercise Expansion	Level 3	Exercise 3

4. Results and Discussion

4.1 Vertical content organization

By analyzing the pre-layout and post-layout extensions of each version of the textbook on the definition of a function, data on the longitudinal content organization of the different versions of the textbook were obtained, as illustrated in Table 4.

Table 4: Comparison of Conceptual Content Organization of Functions in the Three Editions of the Textbooks

Content organization	Z Edition	S Edition	E Edition
Pre-layout	Grade 7 Semester 1-3 Integers, Addition and Subtraction Grade 7 Semester 2-1 Multiplication and division of integers Grade 7 Semester 2-3 Relationships between variables Grade 8 Semester 1-2 Real Numbers Grade 8 Semester 1-3 Position and Coordinates	1A-2 Real numbers 1A-4 Expressing Numbers with Letters 1A-5 Addition, subtraction, multiplication, and division of integers 1B-11 The Law of Numbers 1B-12.1 Cartesian Coordinate System	Algebra 1-2.3 Drawing Algebra 1-2.4 $y = mx + c$
Function	Grade 8 Semester 1-4.1* Functions	1B-12.2 Concepts of Functions	Algebra 2-6.1 Finding rules to discover functions
Post-Extension	Grade 8 Semester 1-4.2 Primary and Proportional Functions Grade 8 Semester 1-4.3 Images of Primary Functions Grade 8 Semester 1-4.4 Applications of Primary Functions Grade 8 Semester 1- 5.6 Quadratic Equations and Primary Functions Grade 9 Semester 1-6 Inverse Proportional Functions Grade 8 Semester 1-2 Quadratic	1B-12.3 Primary Functions and Images 1B-12.4 Slope of a primary function 2A-4 Quadratic Function Images 2A-5.5 Quadratic Equations and Primary Functions 3A-2.2 Applications of Quadratic Functions 3A-6 Power Functions	Algebra 2-6.2 Systems of binary equations Algebra 2-6.5 Changing the subjects within a formula. Number 3-10.5 Substitution in formulae

	Functions		

*Note: 4.1 indicates chapter IV, section I.

The Z and S editions exhibit a comparable level of content and a similar approach to its organization. Prior to introducing the concept of function, students have already undergone sufficient preparation, having already learned the sessions of Addition, subtraction, multiplication and division of integers and Representation of points in a plane. Furthermore, in consideration of the characteristics of students' spiral learning, the study of variables was introduced in the preceding stages of learning, including the Z edition of the Grade 7 Semester 2-3 Relationships between variables and the S edition of 1B-11 patterns of numbers (see Figure 2).

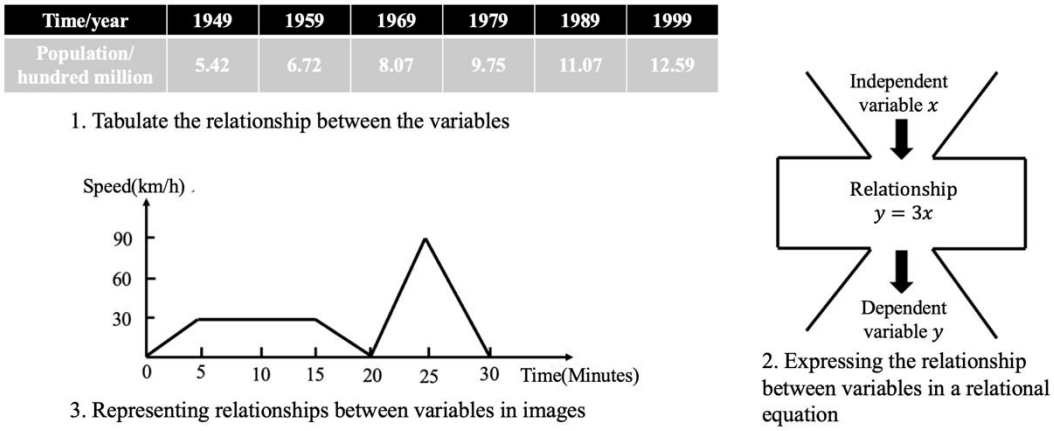

Figure 2-A: Z Edition of Grade 7 Semester 2-3 Relationships Between Variables

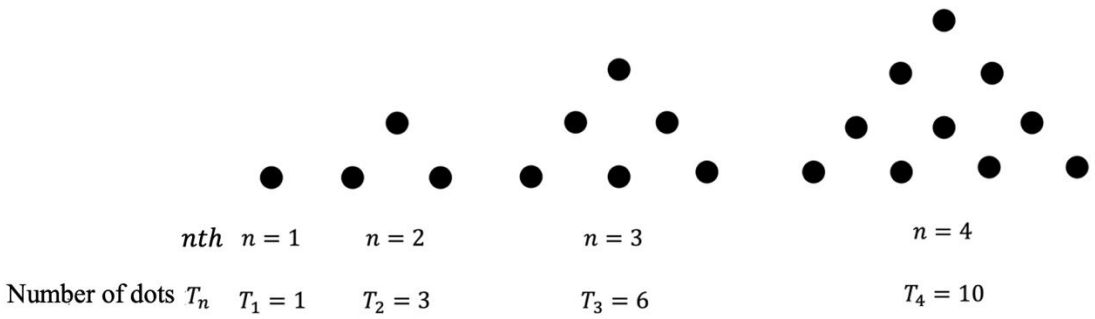

Figure 2-B: S Edition 1B-11 Patterns of Numbers

Figure 2: Comparison of Contents of the Z and S Editions of the Bedding on Relationships

As illustrated in Figure 2-A, the Z edition of the textbook has introduced the three forms of function representation in the semester 2 of Grade 7, despite the absence of the term function at that point. However, students have started to identify the characteristics of the dependent variable in relation to the change of the independent variable. Figure 2-B illustrates that in the S edition of the textbook, prior to learning the concept of function, students have already acquired knowledge of the pattern of numbers. This enables them to begin to grasp the idea that a variable changes in relation to another variable.

Regarding subsequent developments, both the Z and S editions encompass the topics of primary functions, systems of quadratic equations and primary functions, and quadratic functions. The distinction between the two lies in the S edition's earlier introduction of power functions in junior high school, where the use of exponential functions gives rise to a unique inverse function.

In terms of structure of function content, the Z and S editions are characterized by substantial content, transparent regulations and arrangements, and a moderate level of difficulty. In contrast, the E edition of the textbook has placed a relatively low priority on the learning of functions at the junior high school level. Despite the early introduction of functions, the content covered at this stage, as illustrated in Figure 3, primarily comprises fundamental concepts such as graph construction, point location, slope, and intercept calculations, and so forth. These preliminary concepts will also facilitate the subsequent learning of functions at the junior high school level. While these preliminaries facilitate students' comprehension of the relationship between variables, the introduction of functions is not a priority due to the teaching objectives' inclination towards graph construction and graph properties. Regarding extension, the E edition of the textbook does not encompass the topics of inverse proportional function and quadratic function. This is since the IGCSE (Core) textbook is designed for students who require only a fundamental grasp of the essential content, while those seeking a more advanced understanding will need to consult the IGCSE (Extended) textbook. In the latter edition, Chapter 2 addresses the topic of quadratic functions, while Chapter 7 deals with the subject of inverse proportional functions. The E edition of the textbook is distinguished by its layered approach to material presentation and its provision of differentiated content for students with varying needs.

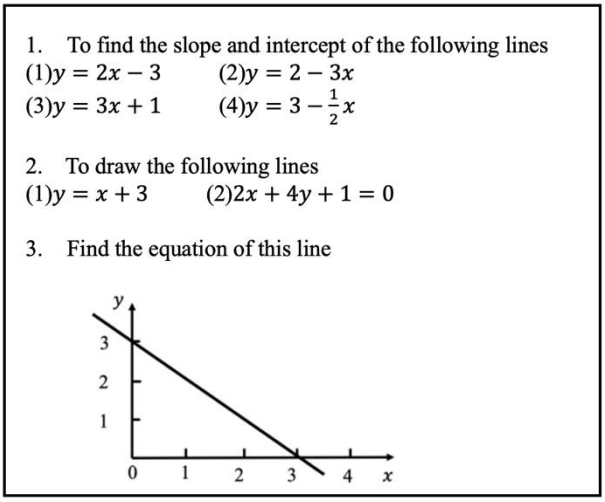

Figure 3: E Edition of Bedding Content on Relationships

4.2 conceptual graph

A concept map of the function definition was created using CmapTools, as illustrated in Figure 4. Figure 4 clearly demonstrates that the depth of the definition of functions module in both the Z and S editions is considerably greater than that in the E edition, regardless of whether the length of the links or the sum of the link lengths is considered. The conceptual setup of the Z and S editions is similar, with both elaborating and transferring concepts from the dimensions of three elements of a function and representation of a function. The only difference is that the S edition also classifies textual descriptions into the category of function representation, which represents an additional method of function representation compared with the Z edition.

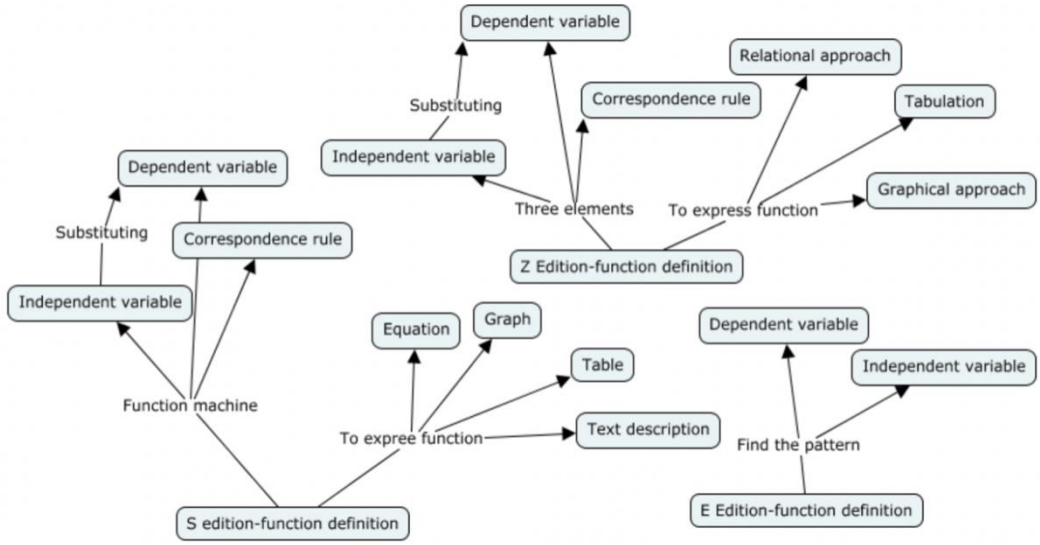

Figure 4: Conceptual Diagram of Three Editions of Function Definition

4.3 Concept acquisition

The three versions of the textbook were dissociated in detail to facilitate the acquisition of the concept of definition of a function. All three versions of the textbook employed the same acquisition of concept formation.

As evidenced in Table 5, the Z version of the textbook employs three scenarios to illustrate the definition of a function in a comprehensive and meaningful manner. In the selected contexts, the three methods of representing functions are also integrated in a clever manner, allowing students to simultaneously learn the definition of functions and experience the methods of representing functions.

Although the S version of the textbook provides only a contextual case, it presents this as a highly engaging activity comprising five questions, namely (1) To guess the rules of this function machine, (2) to fill in the input and output values are presented in the table below.(3) If the input and output values are regarded as ordered pairs of real numbers, trace the points in the cartesian coordinate system. (4) To consider the relationship between the values of x and y. (5) To attempt to construct your own function machine. The responses to these inquiries facilitate the attainment of two levels of knowledge: function definition and approaches to represent function. In the concluding conceptual phase, the Z edition is largely analogous to the S edition.

In the E edition of the textbook, three scenarios are employed to extend the pattern of change in the form of proportional function, linear function, quadratic function, and so forth, thereby enabling students to comprehend the definition of function.

Table 5: Acquisition of Conceptual Formation of Function Definition in Three Editions of Textbook

Concept formation	Z edition	S edition	E edition
Large number of scenarios	Scenario 1: When riding a Ferris wheel, feel how the cover off the ground changes over time. Scenario 2: How the total number of cylindrical objects in the tin box changes as the number of layers increases. Scenario 3: The quantitative	Scenario 1: Constructing a function machine to get a feel for inputting one number and outputting another. Lots of activities to do with input and	Scenario 1: Finding patterns by discovering variations in the arithmetic sequences. Scenario 2: Discovering patterns through discovering the placement of matchsticks. Scenario 3: Finding patterns through changes in square numbers

	relationship between Thermodynamic temperature and Celsius temperature.	output	
Common features	Both have two variables; given the value of one, the value of the other is accordingly determined	Each value has a value that corresponds to it	The ordinal number of terms corresponds to the size of the term
Intrinsic features	Independent and dependent variables; dependent variable changes as independent variable changes	The dependent variable changes as the independent variable changes	The dependent variable changes as the independent variable changes
Conceptualization	If there are two variables x and y in a changing process and, for each value of the variable has a uniquely determined value corresponding to it, then we say that be a function, where x is the independent variable and y is the dependent variable.	If for every independent variable x, there is a dependent variable x corresponding to it, then it is said that it is a function	Relationship in which the dependent variable changes as the independent variable changes

4.4 Case Perceptual Comparison

The contexts used in the three editions of the textbook during the process of concept formation were counted based on the scenario coding table in Table 2. The results are presented in Table 6 below. The textbook of Z edition employs a multitude of contexts to facilitate students' holistic understanding of the definition of function. In contrast, the textbook of S edition is relatively limited in its use of contexts, with only one example of scenario 3. In E edition, the textbook introduced the definition of function using a single example from scenario 2 and two examples from scenario 3.

Table 6: Comparison of Classification of Function Definition Scenarios in Three editions of Textbook

Style	Z edition	S edition	E edition
Scenario 1	1	0	0
Scenario 2	1	0	1
Scenario 3	1	1	2

4.5 Comparison of the number and level of practice questions

The practice questions are divided into two categories: those that are completed in the classroom and those that are completed after school. When counting, each question is counted as one question if there are multiple sub-questions within a topic. To illustrate, Tables 7 and 8 present the number and level of classroom and after-school practice questions in the three versions of the textbook, respectively.

Table 7: Comparison of the Number of Practice Questions in Three Editions of Textbooks

Style	Z edition	S edition	E edition
Classroom practice	3(23%)	11(24%)	3(6%)

After-school practice	10(77%)	34(76%)	46(94%)

Table 7 reveals that the textbook of S edition devotes considerable attention to classroom practice, with 11 classroom practice questions included in that section. In comparison, both Z edition and E edition include only three such questions. However, in terms of the percentage of classroom practice questions, both Z and S editions reached approximately 25%, while the E edition textbook accounted for only 6%. About the number of after-school practice questions, the S and E editions contain three and four times as many as the Z edition, respectively. However, regarding the proportion of after-school practice questions, the Z and S editions are comparable.

In terms of the overall number of practice questions, there is a close ratio of approximately 1:3 between Z edition and S edition. This reflects the pedagogical approach of refinement in the classroom and more practice after class. Nevertheless, the S edition is more extensive, and students utilizing the S edition of the textbook are subjected to greater pressure in the classroom and after school. Conversely, the E version of the textbook places a significant emphasis on post-classroom practice, with 94% of the practice questions being after-class. This approach is designed to assess students' capacity for independent learning and self-management, enabling them to effectively direct their learning efforts amidst a vast array of practice questions.

Table 8: Comparison of the Level of Practice Questions in Three Editions of Textbook

Style	Level	Z edition		S edition		E edition	
		Questions number	Percent	Questions number	Percent	Questions number	Percent
Classroom practice	1	0	0	3	27%	0	0
	2	0	0	4	36%	0	0
	3	3	100%	4	36%	3	100%
	4	0	0	0	0	0	0
After-school practice	1	2	20%	10	29%	0	0
	2	2	20%	15	44%	10	22%
	3	2	20%	6	18%	29	63%
	4	4	40%	3	9%	7	15%

Furthermore, an examination of the three textbooks reveals that the classroom practice in both Z edition and E edition is oriented towards Level 3, which pertains to transferred understanding. The conceptual content and understanding are presented through the organization of the textbook. However, the S edition of the textbook is notably distinct, with the 11 classroom practices distributed evenly across Levels 1, 2, and 3. In consideration of the time constraints inherent to the classroom setting, it is notable that none of the classroom exercises in the three textbooks addressed the area of integrated enquiry.

Finally, regarding the distribution of after-school practices, the Z and S editions of the textbook are well balanced across four different levels. The former places greater emphasis on comprehensive inquiry practices, while the latter is more oriented towards conceptual understanding, accounting for 40 percent and 44 percent, respectively. It can be observed that the two editions of the textbook exhibit a comprehensive and structured arrangement of after-class exercises, which facilitate a gradual and systematic consolidation and reinforcement of the students' learning. In stark contrast, the E edition of the textbook did not include any conceptual content in its after-school practices. Instead, 63 percent of the 46 practices were oriented towards transfer of understanding, which examined the transfer of previously learned concepts to observed

phenomena. This approach aimed to facilitate learning by exemplars.

4.6 Comparison of difficulty levels of practice questions

In consideration of the restricted timeframe allotted for classroom instruction, the level of difficulty inherent to the three textbooks was reflected in the after-class assignments. Table 9 presents the difficulty stratification of the after-class practices of the three textbooks, as obtained from the difficulty coding table in Table 3.

Table 9: Comparison of Difficulty Level of After-class Practice Questions of Three Editions of Textbooks by Tiers

Style	Level	Z edition		S edition		E edition	
		Questions number	Percent	Questions number	Percent	Questions number	Percent
After-school practice	A	6	60%	10	29%	23	50%
	B	1	10%	9	27%	13	28%
	C	3	30%	15	44%	10	22%

Table 9 illustrates that the three editions of the textbooks have incorporated tiered design in their after-class practice questions, thereby catering to students at varying proficiency levels. This, in turn, allows teachers to assign homework in a more efficient manner. In terms of the proportion of difficulty levels, the Z and E editions of the textbook focus on the basics, accounting for 60% and 50% of the content, respectively. In contrast, the S edition of the textbook comprises 44% of challenging questions in the post-class practices, thereby providing an adequate supply of difficult questions for high-performing students.

5. Conclusion and Suggestion

Considering the findings from the preceding analyses and comparisons, it is possible to derive some fundamental conclusions that will facilitate an in-depth examination of the pedagogical preparation of the section entitled Formation of the Concept of Function.

5.1 Conclusion

Regarding the vertical organization of the concept of function, the Z and S editions of the textbook exhibit a greater degree of proximity in their respective approaches. Both versions have established the requisite content prior to the formal introduction of the concept of function. Concurrently, in the subsequent comprehensive examination, they have also made sufficient expansion. In contrast, the E edition of the textbook exhibits a paucity of compilation regarding connotation and extension, thereby precluding students from fully engaging with the depth and breadth of this learning opportunity. A similar phenomenon can be observed in the conceptual maps, whereby the Z and S editions of the textbook present a comprehensive overview, whereas the E edition of the textbook solely addresses the concepts of independent variable and dependent variable.

In the organization of the transversal content, concepts of functions, all three textbooks are presented from the perspective of concept formation. In particular, both Z and E editions employ three scenarios to identify common features. Z edition presents cases distributed evenly among real, imaginary, and purely mathematical scenarios, whereas E edition begins with imaginary and purely mathematical scenarios. In contrast, the S edition of the textbook presents a single case derived from a purely mathematical scenario for the purpose of introducing the concept of functions. It can be observed that the Z edition of the textbook is the most appropriate for introducing concepts, enabling students to transition seamlessly from the perception of graphs in their daily lives to the abstract comprehension of graphs, while simultaneously fostering higher-order mathematical thinking. In contrast, the E and S editions of the textbook necessitate that students intuitively experience mathematical abstraction from mathematical scenarios.

Furthermore, the three editions of the textbook exhibited notable discrepancies in the manner of organization of the practice questions. Firstly, the number of practice problems in both the S and E editions is significantly higher than in the Z edition of the textbook, with the former containing more than three to four times as many. When the exercises are classified as either classroom or after-class, the Z and E editions are arranged in a ratio of 1:3, reflecting the ratio of intensive lectures in the classroom to exercises to be completed outside of class. Secondly, with regard to the level of the practices, it can be observed that the three classroom practices in the Z and E editions of the textbook are all focused on the transfer of understanding, whereas the 11 classroom practices in the S edition of the textbook are divided into the following categories: conceptual, conceptual understanding, transfer of understanding, which are particularly effective in assessing and reinforcing students' comprehension of fundamental concepts. Ultimately, regarding the difficulty of the after-class practices, all three editions of the textbook demonstrate a commitment to hierarchical organization, which is conducive to catering to students with varying levels of proficiency. Concurrently, this approach offers Math teachers a framework for assigning practices of increasing complexity.

5.2 Suggestion

This paper presents the findings of a comparative study of the three editions of Chinese, Singaporean and British textbooks on the arrangement of the content of the concept of function. Based on this analysis, three suggestions are put forth for the subsequent development of the chapter on the concept of function in Chinese mathematics textbooks.

Firstly, the definition of function in the Chinese textbooks is comprehensive and accurate in terms of both connotation and extension, encompassing a broad and nuanced understanding. However, in the scenario aspects of concept formation, in scenario 3, the choice of purely mathematical context, the original scenario is the Thermodynamic temperature and the Celsius problem. This illustrates the relationship between independent variable and dependent variable from the perspective of a purely mathematical relational equation. It is therefore evident that this scenario is somewhat inappropriate for the introduction of function concepts to Chinese junior high school students, given that they have no life experience base for thermodynamic problems and rarely encounter such problems since childhood. Consequently, we adopted the classroom activity of function machine from the Singaporean textbook to facilitate students' intuitive comprehension of the relationship between the independent variable corresponding to input and the dependent variable corresponding to output, facilitating the transformation of abstract understanding into a more intuitive one.

Secondly, regarding the classroom practices, the Chinese edition of the textbook addresses the level of transferable understanding, which may present certain challenges for students engaged in independent learning. In this instance, the Singaporean edition of the textbook can be employed to reduce the number of classroom practices.

Thirdly, the Chinese edition of the textbook contains a limited number of questions in its after-class practices, which presents challenges for teachers in assigning homework and selecting exercises. Considering the design intention of differentiated teaching evident in the after-class practices, the number of topics can be aligned with those in the Singaporean and British editions of the textbook. These versions provide enough after-class practices at different levels, offering a valuable resource for students and teachers alike.

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