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Reproduction of social inequality through selection and transmission of pedagogic messages in Chinese mathematics classrooms

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ABSTRACT

This article investigates how social inequality is reproduced through the recontextualization of mathematics pedagogy, using Dowling's social activity method as an analytical framework. The study identifies the selection and transmission of pedagogic messages as a potential pathway. Findings indicate that teachers in upper-stream schools favour abstract, context-independent messages and metonymically organize tasks to maintain their messages in esoteric mathematical domain. In contrast, their middle- and bottom-streams counterparts often select everyday, context-dependent tasks and assemble tasks metaphorically, limiting students' access to the abstract mathematical system. These results suggest that class differences are transformed and legitimized through the differential selection and transmission of pedagogic messages, shaping students' social consciousness in different ways and perpetuating social stratification.

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Introduction

Many scholars have explored how schooling, established to serve the economic development and ideological control needs of the ruling class, reproduces social inequality (Althusser 2001; Bourdieu 1973; Bowles and Gintis 2002). However, this argument has been criticized for its determinism, which overlooks students' agency and resistance (Jenkins 1982). The question of why dominated groups accept their subordinate positions, rather than challenge them, remains inadequately addressed. This study seeks to explore this issue by examining the process of recontextualization, wherein macro social rules are transformed into micro-level classroom pedagogy. Through subtle, everyday pedagogic practices, class differences infiltrate and shape students' social consciousness, ultimately leading to the acceptance and internalization of their social positions, thereby maintaining the reproduction of social stratification (Bernstein 2003a).

Empirical studies in China have demonstrated a positive correlation between students' academic achievement and their family backgrounds (Huang and Cheng 2011; Xiao et al. 2009; Zhang et al. 2005). Mathematics, as a gatekeeper to prestigious universities and

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higher-paying professions, serves as a key indicator of academic success and social divisions of labour, offering a valuable context for exploring the broader inequalities embedded within the education system (Jorgensen, Gates, and Roper 2014). However, while the influence of social background on achievement is well-documented in social and linguistic subjects, the role of mathematics education in reinforcing social segregation remains underexplored. The abstract, logical nature of mathematics, along with its standardized content, curriculum, and assessment, has fostered a widespread belief that mathematics is less affected by students' socioeconomic status. High achievers in mathematics are often perceived as possessing innate talent rather than benefiting from privileged backgrounds. Yet, scholars argue that all knowledge, including mathematics, is pedagogized and incorporates social and cultural elements, thus legitimizing and transmitting ideologies (Bernstein 2000; Dowling 1998; Singh 2002). In this light, mathematics subtly perpetuates class boundaries by transmitting knowledge that appears objective but is ideologically laden (Straehler-Pohl and Gellert 2013).

This study focuses on micro-level mathematics classroom, investigating whether class-based differences are present in selection and transmission of pedagogic messages in order to recover their underlying regulative principles. The study aims to uncover how class differences are transformed and legitimized through differential pedagogic practices for students from varying social backgrounds, thereby invisibly maintaining social stratification.

Theoretical framework

This study utilizes Social Activity Method (SAM) developed by Dowling (1998) as the analytical framework. Building on Bernstein's work, Dowling constructed SAM to link implicit regulative principles with various social practices. He adopts the term "activity" because, in his view, an activity is generated by the division of social labour and is governed by underlying social rules. Meanwhile, activity is the contextualized basis of social practices, as the realization of any social rule necessitates specialized activities. Thus, SAM provides a framework for analyzing social practices to uncover their underlying regulative principles. School mathematics, as a specialized activity in pedagogic practices, is also governed by the social rules within which they occur.

Dowling's SAM focuses on pedagogic texts to analyze how teachers, as recontextualizing agents, transform and legitimize class differences through the differential selection and transmission of pedagogic messages carrying varying degrees of abstraction of knowledge representing different hierarchical power relations (Bernstein 2000). Drawing on structuralist linguistics, Dowling structures SAM into two dialectically related levels: the structural level and the textual level. The structural level governs the textual and can only be accessed through textual analysis. He further introduces the "resource level," focusing on the inherent resources within pedagogic texts, as a supplementary analytical dimension. These levels collectively form the analytical framework for this study, frequently intertwining during the analysis.

The structural level

Within a given society, activity is articulated through signs that regulate both the subjects and the content of these signs, which Dowling defines as positions and practices, respectively. Activity constructs subjects by distributing practices across hierarchical positions, which are inseparable and function as relational totalities within the activity. For example, in school mathematics, the relationship between practices (e.g. mathematical and pedagogic knowledge) and hierarchical positions (e.g. teachers and students with varying levels of authority) illustrates this dynamic.

Domains of practice

Dowling recontextualizes Saussure's linguistic sign, consisting of the signifier and the signified, to deconstruct pedagogic practices into the dimensions of expression and content. He incorporates Bernstein's (2003b) concept of strength of classification to represent the degree of specialization (Dowling 1998; Hoadley 2008). Taken together, Dowling develops a matrix of four 'domains of practice,' which classify school mathematics based on its degree of specialization in both symbolic and content dimensions (see Figure 1):

(a) The esoteric domain, characterized by strong classification in both expression and content dimensions, is marked by abstract mathematical symbols and specialized topics such as geometry and algebra. In this domain, ambiguity is minimized, and specialized denotations and connotations are prioritized. The governing principles of mathematical practices can be fully expressed within this domain.

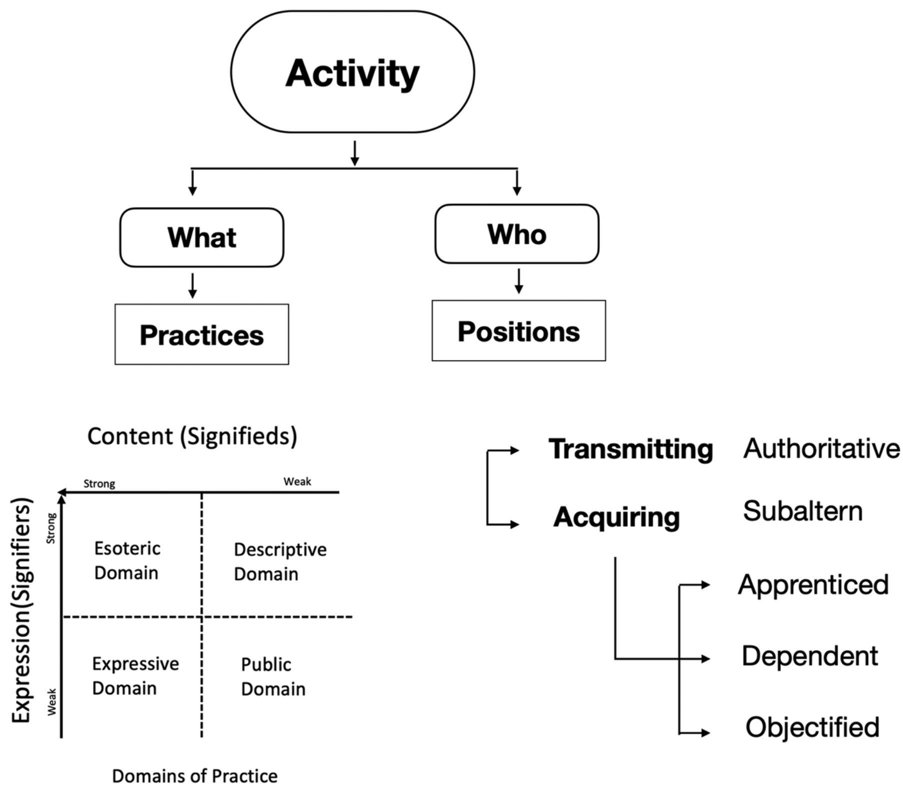

Figure 1. Dowling's activity at the structural level.

(b) The descriptive domain emerges when abstract mathematical symbols are presented within non-mathematical contexts, such as calculating running speed.
(c) The expressive domain refers to cases where non-mathematical symbols are integrated into specialized mathematical content, such as distributing pizza among people to learn fraction (Koustourakis and Zacharos 2011). As a result, 'regulative principles of the esoteric domain cannot be fully expressed within this domain' (Dowling 1998, 136).
(d) In public domain, both symbols and content are non-mathematical and closely related to the real world and are highly related to students' everyday activities, such as shopping.

Positions and subjectivity

In school mathematics, pedagogic practices construct hierarchical positions among teachers and students based on factors such as ability and age. Teachers are typically positioned as authoritative transmitters of pedagogic messages, while students are cast as subordinate acquirers. Students' hierarchical positioning is determined by their ability to realize the regulative principles of the esoteric domain, which is also the extent of their subjectivity produced.

Initially, accessing the esoteric domain through pedagogic practice involves a process akin to 'apprenticeship', during which students' subjectivity is produced. In this phase, students engage with abstract, decontextualized mathematical tasks that are metonymically linked to the regulative principles of the esoteric domain. Teachers, functioning as adepts imparting their specialized knowledge, guide students through these tasks, facilitating their progression from novices to potentially experts. As a result, students are positioned as 'apprenticed'.

However, when students' access to the esoteric domain is usually interrupted or denied—possibly due to pedagogic actions such as the recontextualization of tasks to less specialized domains or a reduction in a mathematical concept by using multiple similar—students cannot fully grasp the regulative principles of the esoteric domain. Dowling terms this position as 'dependent', reflecting a limitation in students' understanding of the complexity of the mathematical system and in their production of subjectivity.

Finally, when students engage with tasks selected from the public domain, which prioritize students' daily experiences over mathematical principles, they are presupposed not as solvers of mathematical problems but as participants in a domestic setting. This leads to their fully 'objectified' position, where their subjectivity is zero.

In summary, at the structural level of SAM, specialized activities regulate both their practices and the hierarchical positions of participants. These activities are categorized into four distinct domains based on the degrees of their mathematical specialization. Simultaneously, participants are assigned hierarchical positions based on their access to the regulative principles of the esoteric domain. These concepts are illustrated in Figure 1.

The textual level

The textual level serves as the gateway to the structural level, where practices and positions constitute the underlying, often invisible, structure of specialized activities. Dowling asserts that all real-world practices (text-as-work) can be translated into text (text-as-text) through induction or deduction, granting access to inner structures, i.e. esoteric theories or discourses.

Practices and positions at the structural level correspond to messages and voices at the textual level, respectively. The distribution of practices constructs positions, which can only be examined through textual analysis of the messages. Messages, in turn, are transmitted and distributed among various subjects according to specific strategies that are specialized to pedagogic texts. These strategies encompass both textual and discourse dimensions, functioning to specialize their voices.

Textual strategies

Textual strategies refer to approaches conducted by an author in address a text to align with the codes (e.g. age, educational background) of their model readers to enhance communicative effectiveness (Eco 1981). In pedagogic contexts, teachers are by default considered as authoritative transmitters and students as subaltern acquirers. Teachers employ textual strategies to convey instructional messages, which can be classified as either expanding or limiting.

Expanding strategies broaden the range of messages from the esoteric domain, transmitting abstract, decontextualized, and generalizing content aligned with the intellectual division of labour. These strategies are linked to authoritative or apprenticed voices, reflecting the process by which an expert teaches a novice. Limiting strategies, by contrast, confine messages to a concrete, contextualized range, aligning with the manual division of labour and subordinately dependent voices. An extreme form of limiting strategy, where esoteric messages are entirely excluded, gives rise to an alienated voice.

Discourse strategies

Discourse strategies refer to the methods used to link multiple pedagogic tasks, depending on whether the connections are metonymic or metaphorical. These strategies determine whether classroom discourse remains abstract or particular and are thus categorized as either abstracting or particularizing.

Metonymic connections link tasks based on their contiguity or proximity, such as whole-part relationships or logical sequences. Messages, as signifiers, are combined metonymically, meaning they continuously refer to other signifiers without entering the realm of the signified—that is, without incorporating concrete elements of the real world (Lacan 2001). As a result, the discourse remains at an abstract level, accessible only through the students' intuition. Students who grasp these abstract tasks enter into the hierarchical power relations embedded in esoteric messages.

Metaphorical connections, by contrast, assemble tasks or topics based on their similarity. This strategy presents multiple tasks to articulate their similarity, i.e. the new mathematical content. By employing metaphorical connections, esoteric knowledge is deconstructed, reducing its level of abstraction. Consequently, students engaged with these procedurally presented messages may not fully access the hierarchical power relations carried by the abstract mathematics knowledge.

Strategic space for general instruction

Dowling combines message strategies (expanding and limiting) with discourse strategies (metonymic and metaphorical) to create a two-dimensional strategic space for assessing teachers' general instruction. Four modes of instruction emerge: *generalizing* is a combination of expanding message strategy and abstract discourse strategy, enabling full access to the power relations embedded in the esoteric domain. This mode aligns with abstract mathematics and positions students as apprentices. *Specializing* assembles public domain messages within an abstract discourse, where these messages function as a portal to the esoteric domain. This space operates as a branch of the esoteric domain—like academic mathematics—facilitating the training of individuals to become specialists, whose voice is specialized as apprenticed. *Fragmenting* refers that teachers expand messages selected from the esoteric domain, but link them metaphorically, resulting in discourse that is more particular than abstract. Consequently, the transmitted esoteric messages become embedded in various settings, causing the esoteric content to be segmented and not fully articulated, which positions students as dependent. *Localizing* involves the gradual elaboration of messages from the public domain, where topics are metaphorically assembled, making them context-dependent and accessible to students. However, these messages remain within the real-world contexts and do not incorporate esoteric content, thereby limiting access to the power hierarchy and specializing the voice of students objectified. The structure of strategic space provides a systematic approach for measure teachers' instructions, as illustrated in Figure 2.

The resources level

Dowling categorizes the textual resource into three types: icon, index and symbol, according to their distinct ways of representation in the practice of signifying. Specifically, the categorization is based on whether these three modes of representation provide readers a sense

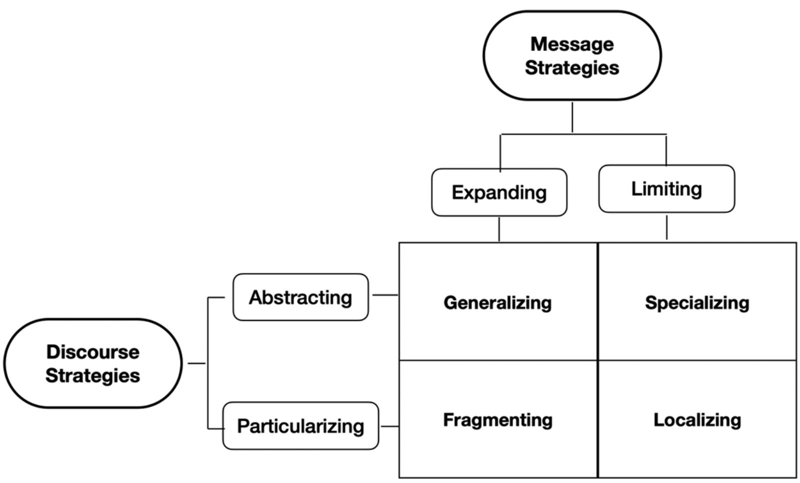

Figure 2. Dowling's activity at the textual level.

of presence or influence their perception of spatial locations. The three modes of representation are:

Iconic modes

Iconic modes primarily involve visual images that can unconsciously immerse students in virtual scenarios during tasks. For example, domestic visuals, such as supermarket shopping images, are commonly used to supplement mathematical exercises. However, these detailed visual icons often place students in specific scenarios, causing them to perceive themselves as spectators rather than readers. As a result, these icons alter students' spatial perception, making them feel as if they are physically present in a virtual scene. This immediate and unmediated experience imposed by iconic symbols can limit the transmission of abstract or specialized symbols. Tasks utilizing iconic modes are often drawn from the public domain, where the excessive use of non-mathematical symbols in pedagogic texts localizes and contextualizes specialized content. As a result, iconic modes tend to align closely with the public domain.

Index modes

Index modes refer to signs that represent mathematical objects, such as diagrams and geometric figures. While these modes provide visual representations, they do not offer an immersive experience. Instead, their primary function is to serve as explanatory tools, helping students engage with mathematical tasks. Acting as a bridge between the tangible world and the abstract mathematical system, index modes grant access to the mathematical domain without altering students' spatial perception. They are commonly used in both expressive and descriptive contexts.

Symbolic modes

Symbolic modes primarily involve alphanumeric text, which forms the basis of mathematical symbols. These symbolic modes do not provide any means of changing students' spatial perception, making students are completely free. These symbols convey mathematical concepts as they are, namely, the mathematical symbols of the esoteric domains, like equations, algebraic expression. Similar to index modes, symbolic modes do not offer students a sense of immersion in the signs to alter their spatial locations. Instead, these modes place students in the role of passive observers, requiring them to identify the messages contained in pedagogic texts. As a result, students become alienated from reality, as the knowledge is abstracted and separated from practical, real-world contexts. Symbolic representations can effectively convey abstract mathematical knowledge without the need to recontextualize these concepts into non-mathematical contexts to enhance student engagement.

Methodology

Data were collected from the *One Teacher, One Excellent Course* platform, an initiative by the Chinese Ministry of Education that enables teachers to share instructional videos and materials, enabling them to receive peer feedback and enhance their teaching skills. The rationale for utilizing video data is that, as part of my doctoral study, data were collected during the COVID-19 pandemic under the constraints of official policies in China, which made classroom access impossible. Additionally, multi-angle video recording provides a richer dataset, capturing detailed instructional content selected and strategies employed by teachers. As the object of analysis is pedagogic messages, participant observation in classrooms is not necessary.

A stratified random sample of 33 videotaped lessons was selected from three school streams in Xi'an, China: upper stream (urban elite, $N = 11$), middle stream (urban public, $N = 11$), and bottom stream (rural public, $N = 11$). Xi'an was chosen due to its representative school characteristics, diverse migrant population, and distinct urban-rural disparities. School streams were categorized based on students' socioeconomic status (SES) they serve, a classification shaped by the Household Registration System (Hukou) (Tao, Yang, and Li 2010). The Hukou-based social structure in China categorizes schools into three distinct streams: the upper stream, which serves urban residents; the middle stream, which caters to the children of migrant workers; and the bottom stream, which predominantly serves the rural population. An independent t-test revealed no significant differences in class size across the school streams.

The unit of analysis spans from preparation to presentation of new mathematical content, structured by the Herbartian five-step model: preparation, presentation, association, generalization, and application (Vadohej, Bilali (Halluni), and Kroni 2015). Preparation involves activities to engage students, while presentation is where teachers officially introduce new content to their entire class, typically providing essential details such as definitions and properties. In Chinese classrooms, the latter steps are often condensed into exercise and summary, which focus on reinforcing content and facilitating generalization (Xu 2010). Thus, new mathematical concepts or symbols are not introduced beyond the first two stages.

This study investigates class-based differences in pedagogic message selection during the preparation phase and how these messages transition from preparation to presentation. Data from 33 lessons were coded and analyzed according to the routine outlined in Figure 3. Three extracts from schools across different streams were selected to illustrate how class differences are recontextualized in micro-level mathematics pedagogy.

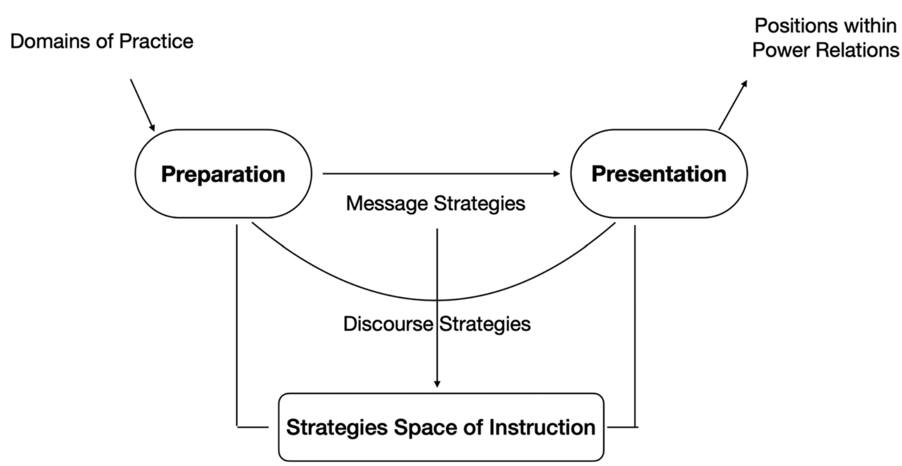

Figure 3. The analysis scope and procedures.

Data analysis

Extract 1

('T' refers to the teacher, 'S' followed by a number indicates the specific student responding individually, and 'Ss' refers to the entire class.)

(1) Teacher: Let's look at the first question. Can you divide a triangle into four congruent triangles? Who would like to share your results? S1.
(2) S1: I took the midpoints of the triangle's three sides.
(3) T: How did you find that out?
(4) S1: We learned about equilateral triangles. By connecting the midpoints, we got four congruent equilateral triangles. I thought it might work here.
(5) T: How did you check congruence?
(6) S1: I stacked them on top of each other, and they matched perfectly.
(7) T: Good. Please sit down, well done. We often consider problems in a particular way. Any different ideas? S2, please share.
(8) S2: I noticed it asked for dividing into four congruent triangles, so, since congruent triangles have equal sides, I…
(9) T: Congruent triangles must have equal sides?
(10) S2: Yes, so I took the midpoints, cut along the lines and found they were congruent.
(11) T: Good, please sit down. Well done. You identified the clue about equal sides to solve the problem. Any other methods of dividing? What if you didn't use those three lines? (No response) Everyone used the same method. Yesterday, the triangles we had were of various shapes and sizes. All could be divided into four congruent triangles using these three lines, showing these lines are very special; they are another important type of line in a triangle. We call them the midsegments of a triangle. Today, let's study them.
(Teacher writes '6.3 Midsegments of a Triangle' on the blackboard)
(12) T: First, I'll ask a student to describe what a midsegment of a triangle is, based on the diagram. S3.
(13) S3: A line segment connecting the midpoints of any two sides of a triangle is called a midsegment of the triangle.
(14) T: Good, please sit down. You described the midsegment accurately! We call a line segment connecting the midpoints of two sides of a triangle a midsegment of the triangle. (The teacher writes the definition on the blackboard) Now, please draw a triangle and its midsegment. (Students work individually)
(15) T: Let's understand the definition further with the diagram (on the Slide). According to the definition, if AD equals BD, and AE equals EC, we can conclude…?
(16) Ss: DE is a midsegment of triangle ABC.
(17) T: Using symbolic language, because of AD = BD, AE = EC, then DE is a midsegment of ΔABC; Conversely, if DE is a midsegment of ΔABC, we can conclude?
(18) Ss: AD = BD, AE = EC.
(19) (Teacher writes 'since AD = BD, AE = EC' on the blackboard)
(20) T: So, because DE is a midsegment of triangle ABC, AD equals BD and AE equals EC. This definition has dual meanings: identify a midsegment and applying it as a basic property. Now, how many midsegments does a triangle have?

(21) Ss: Three.
(22) T: Three midsegments. When we think of midpoints, we often associated them with a triangle's?
(23) Ss: Median.
(24) T: So, what's the difference between a midsegment and a median? S4, please explain.
(25) S4: A midsegment connects the midpoints of two sides, while a median connects a vertex to the midpoint of the opposite side.
(26) T: Correct, the midsegment connects the midpoints of two sides, while the median connects a vertex to the midpoint of the opposite side.

This extract is from an upper-stream classroom, where the transition from preparation to the introduction of new content is clearly delineated. The teacher's statement, *"These three lines… Today, let's study them"* (Line 11), combined with writing *"6.3 Midsegments of a Triangle"* on the blackboard, signals the shift to new content. Accordingly, content prior to line 11 is categorized as preparation, while content from Line 11 onward marks the start of new mathematical instruction.

The structural level

The pedagogic messages in the preparation phase are coded with strong classification in both content and expression, situating the teacher's practice firmly within the esoteric domain. In terms of expression, all symbols, such as "congruent triangles" and "midpoints," are mathematically specialized. Regarding content, the task is highly context-independent, focused on a geometric topic. Although the task involves a hands-on activity (paper cutting), the content—"cutting out four congruent triangles"—is isolated from any everyday context and exists exclusively within the mathematics classroom. The strong classification in both dimensions confirms that this task belongs to the esoteric domain, distinguishing it from other activities.

The construction of students' positions and subjectivities involves their continuous acquisition of new, abstract symbols from the esoteric domain—a process of subject production in which they progress from incompetence to competence within a specialized field. In this extract, the teacher first invites students to share their methods, using questioning to guide them in articulating their strategies. By evaluating and summarizing the students' ideas, the teacher transitions to presenting new mathematical content, thus entering the esoteric domain. Within this pedagogic relationship, the teacher functions as an 'adept,' transmitting abstract mathematical symbols to the 'novice' students, aiming to cultivate them into potential experts. Through sustained questioning, the teacher maximizes students' subjectivity within a strongly classified activity, positioning them as 'apprentices.' At the structural level, the upper-stream teacher begins the lesson in the esoteric domain, inducting students into hierarchical power relations through the acquisition of specialized knowledge.

The textual level

The message strategies are identified as expanding, and the discourse strategies as abstracting. The teacher organizes the instructional tasks into four parts: asking two students to share their respective solutions to the task, presenting new mathematical content in detail, and prompting a student to compare the properties of midsegments and medians to enhance understanding. Throughout these tasks, the teacher gradually expands the messages from the esoteric domain. Initially, by asking, 'Can you divide a triangle into four congruent triangles?' and then summarizing the students' responses to expand the mathematical messages like 'midsegment' (Line 11). Subsequently, she introduces the new content of midsegments by engaging a student (Line 13) and providing geometric and symbolic representations (Line 15). Finally, the teacher revisits the concept of the median to reinforce understanding. Through this structured process, the esoteric mathematical content—comprising abstract terms and symbols—is progressively broadened.

The discourse strategy is abstracting, identified by metonymic connections between tasks. The first two tasks involve eliciting different solutions to the same problem. These different solutions represent distinct parts of a whole and are inherently parallel, creating a metonymic relationship. Without intuition, students may struggle to see the connections between these tasks. The teacher then generalizes these specific tasks to an abstract level, explicating the properties of midsegments. In the subsequent task, the teacher contrasts the previously learned concept of the median with the midsegment, both of which are properties of triangles, reflecting a metonymic relationship. Thus, these metonymically connected tasks make the discourse strategies abstracting.

Together, the expanding message strategy and abstracting discourse strategy place the teacher's instruction in the strategic space of generalization. Students consistently acquire these esoteric symbols, leading to the specialization of their voices. Ultimately, students are positioned within hierarchical power relations through the acquisition of valued mathematical knowledge.

The resource level

In this extract, the teacher employs symbolic modes, such as geometric figures and terms, which function autonomously within the mathematical discourse without representing anything beyond their inherent properties. Students engaged exclusively to these specialized mathematical symbols, without any alteration in their sense of spatial or conceptual positions. Their role is limited to being readers of these texts, observers of the mathematical tasks, and solvers of the posed questions, granting them access solely to the domain of pure mathematical symbols. As a result, the regulative principles of the esoteric domain can be fully realized. This result aligns with Dowling's argument that recruiting substantially from symbolic mode facilitates the generalizing strategies which are necessary in the construction of positions of 'apprenticed'.

Extract 2

In English, both numeric and algebraic fractions are called 'fractions,' but in Chinese, they are distinct concepts. 'Fenshu' refers to numeric fractions and 'Fenshi' to algebraic ones. For clarity, I will use these Chinese terms to differentiate between them.

(1) (The teacher wrote the goal on the board: Addition and subtraction of Fenshi with the same denominator. He then displayed review exercises on Fenshu 1. $\frac{1}{5}+\frac{2}{5}=$ 2. $\frac{1}{5}-\frac{2}{5}$, =. Students quickly responded, and two were selected to explain their methods.)

(2) S1: There is one $\frac{1}{5}$ inside $\frac{1}{5}$, there are two $\frac{1}{5}$ inside $\frac{2}{5}$, one $\frac{1}{5}$ plus two $\frac{1}{5}$ equals three $\frac{1}{5}$ is $\frac{3}{5}$.

(3) S2: There is one $\frac{1}{5}$ inside $\frac{1}{5}$, two $\frac{1}{5}$ inside $\frac{1}{5}$, one $\frac{1}{5}$ minus two $\frac{1}{5}$ equals to one negative $\frac{1}{5}$ which is - $\frac{1}{5}$.

(4) (The teacher praised their answers and encouraged the class to applaud)

(5) T: After these exercises we have clarified addition and subtraction of Fenshu with the same denominator. Who can summarize the rule?

(6) S3: Keep the denominator and subtract the numerators.

(7) T: Right, very good. Read it together.

(8) (The teacher showed this law on slide and the class read it collectively. The teacher affirmed the rule and introduced two new exercises on the slide.)

(9) Exercise 1. $\frac{1}{a}+\frac{2}{a}=$; Exercise 2. $\frac{1}{a}-\frac{2}{a}=$

(10) T: Please take out your exercise book. When you finish, discuss your ideas with your desk mate.

(11) (Students worked individually, while the teacher circulated. He then called on a student to answer the first exercise.)

(12) T: S4, answer the first question.

(13) S4: $\frac{1}{a}$ plus $\frac{2}{a}$ equals to $\frac{(1+2)}{a}$ which is equal to $\frac{3}{a}$.

(14) T: Very good, can you explain your method?

(15) S4: Because there is one $\frac{1}{a}$ in $\frac{1}{a}$ and two $\frac{1}{a}$ in $\frac{2}{a}$, one $\frac{1}{a}$ plus two $\frac{1}{a}$ equals three $\frac{1}{a}$, that is $\frac{3}{a}$.

(16) T: Right? (The class answers 'right'.) Well, very good, applaud! You said it particularly good! Your language is very accurate, and you say it in a very standardized way. Who would like to answer the second question? S5, try it, say it boldly.

(17) S5: $\frac{1}{a}$ minus $\frac{2}{a}$ equals $\frac{1-2}{a}$ equals one negative $\frac{1}{a}$, that is negative $\frac{1}{a}$.

(18) T: OK, can you explain your method?

(19) S5: Yes. Because there is one $\frac{1}{a}$ in $\frac{1}{a}$ and two $\frac{1}{a}$ in $\frac{2}{a}$, one $\frac{1}{a}$ minuses two $\frac{1}{a}$ equals one negative $\frac{1}{a}$, namely negative $\frac{1}{a}$.

(20) T: Very good, applaud him. We found we could solve new problems using the law of Fenshu with the same denominator we have reviewed. Right? (Class answers 'Yes.') Then look at these two equations, what is different from what we just learned?

(21) Ss: The denominators.

(22) T: Right, what changed about the denominators? (Ss: letters). Correct, when the denominator becomes Fenshi. We learned this two days ago: an algebraic equation

with a letter in the denominator is called Fenshi. Now it's turned into Fenshi, so we've solved today's problem of adding and subtracting Fenshi with the same denominator using the same method for Fenshu, right? Well, great discovery. Have you noticed anything during your calculations? What has changed? What hasn't? Who's going to say? S6.

(23) S6: The denominator doesn't change, the numerator changes.

(24) T: The denominator doesn't change, the numerator changes. So, look: $\frac{1}{a}$ plus $\frac{2}{a}$ equals to $\frac{1+2}{a}$. It adds up the numerators, and $\frac{1}{a}$ minus $\frac{2}{a}$, equals to $\frac{1-2}{a}$. Does it add and subtract the numerators, and does the denominator change?

(25) Ss: No.

(26) T: The denominator doesn't change. Then, think about it, according to the law of adding and subtracting Fenshu with the same denominator we just reviewed: addition and subtraction of Fenshu with the same denominator, the denominator remains the same, add and subtract the numerators. Right? Can someone tell us, what is the rule of addition and subtraction of Fenshi with the same denominator? Based on the rule of Fenshu, how should the law for addition and subtraction of Fenshi with the same denominator be recounted?

(27) S7: For addition and subtraction of Fenshi with the same denominator, keep the denominator the same, add and subtract the numerators.

(28) T: Correct? (Class answers 'Correct', and then the teacher asked for a round of applause, displayed the rule on a slide, and asked the students to read it aloud. Simultaneously, the teacher wrote the rule on the blackboard and had the whole class to read it again before moving on to the exercises.)

This case involves a middle-stream teacher. Presenting new mathematical content requires more than just naming a concept; it needs thorough explanation. Writing the topic on the board doesn't count as the presentation stage. However, the teacher's statement, 'Now it's turned into a Fenshi, …right?' (Line 22), signals the transition from preparation to presentation, as the focus moves from Fenshu rules to the introduction of Fenshi rules.

The structural level

This extract is clearly situated within the esoteric domain. The lesson focuses on algebra, specifically the addition and subtraction of *Fenshi* with the same denominator (Line 1), a topic that is inherently algebraic and abstract, indicating strong content classification. The use of symbols within arithmetic field, such as *Fenshi* and the negative sign, underscores the strong classification of expression, firmly placing the pedagogic task within the esoteric domain.

The strong classification in both expression and content allows students to distinguish this specialized mathematical activity from other contexts, such as everyday life or other academic subjects, reinforcing their development as potential experts. However, the relationship between tasks is metaphorical, with similarities that make them more accessible. However, despite exposure to esoteric symbols, the procedural introduction of symbols interrupts students' access to the full complexity of the mathematical system, resulting in only a surface level grasp of the content. Consequently, the students' position is constructed as 'dependent,' reflecting limited engagement with the abstract mathematical knowledge. Therefore, only a residual subjectivity is produced.

The textual level

This teacher employs an expanding message strategy and a particularizing discourse strategy. The expanding message strategy is evident as the teacher broadens the abstract mathematical symbols from the preparatory activities to the presentation of new content. The lesson begins with a task involving Fenshu calculations, prompting students to recall operational rules. The teacher then introduces additional mathematical symbols, such as $\frac{1}{a}+\frac{2}{a}$ and $\frac{1}{a}-\frac{2}{a}$, progressively expanding the mathematical expressions.

The discourse strategy is characterized by particularizing through metaphorical connections between tasks. The teacher introduces four tasks that share a common operational principle: maintaining the denominator while adding or subtracting the numerators. After these exercises, a student articulates the operational law, which is then presented on a slide and recited by the class (Lines 5-7). The teacher reinforces this principle with two additional exercises, emphasizing that they can be solved using the same principle of Fenshu.

Moreover, when students explain their approaches, their responses are remarkably uniform. The first student's answer (Line 2) is closely mirrored by subsequent students, with only the mathematical symbols varying according to each task (Lines 3, 13, 15). This consistency, particularly seen in Student 4's response (Line 15), is validated by the teacher's positive feedback, either as recognition of the correct application of previous methods or as an acknowledgment of the task similarities. This validation suggests that the teacher values the use of metaphorical connections, which diminishes the complexity of mathematical system and denies students' access to its underlying regulative rules.

Together, the expanding message strategy and particularizing discourse strategy create an instructional space of fragmenting. While students are introduced to esoteric mathematical knowledge, it is presented in a simplified, easily digestible form, preventing full engagement with deeper mathematical concepts and positioning students as 'dependent.'

The resource level

The textual resources employed in this extract are predominantly symbolic. Expressions such as arithmetic formulas have been identified as esoteric at the structural level, specifically transmitting the content of specialized algebraic topics. For the students, there is no change in their sense of spatial or cognitive orientation, nor any confusion with other activities, reinforcing the specialized nature of these symbols. However, it is important to note that the resource level serves as an auxiliary dimension in the overall analysis. The teacher's subsequent organization of these symbols, based on their structural similarities, is intended to facilitate student comprehension. Consequently, this approach does not culminate in a generalizing strategy in instruction but instead conveys fragmented knowledge within the esoteric domain.

Extract 3

(1) The teacher displayed a task on a slide, 'The Meaning of Average Depth of Water: Ming, an eighth grader in Chang'an District, is 1.75 meters tall. A pond with an average depth of 1.5 meters near his school. He plans to go swimming there alone during the summer. What safety risks does this pose?'

(2) S1: The average depth of 1.5 meters suggests the pond could be deeper or shallower in places.

(3) T: Correct. The average depth indicates variability, with some areas deeper than 1.5 meters. Is Ming's height at risk?

(4) SS: Yes.

(5) T: Anything else?

(6) S2: Swimming alone in a pond is dangerous.

(7) T: Exactly, that's not allowed. These are just ideas, don't act on them.
(The teacher provided the second task through presenting a graph of shooting scores for three individuals, A, B, and C, and asked which had the most consistent and best scores. A student responded that B's scores were more consistent and better because they fluctuated less compared to A, whose scores varied widely. The teacher confirmed this observation.)

(8) (Teacher displays the title of the new concept on slide: Analyzing Data - The Mean Value)

(9) T: In this chapter, Ming's school achievement is in moderate level in our class. … With the progress of society, we have entered the era of big data. Then the analysis of data is becoming important. So, this lesson we will start from the most basic concept: the mean value.
(The teacher provided an example of calculating the arithmetic mean using a student's test scores of 87, 90, and 93. A student correctly calculated the mean as 90 by adding the scores and dividing by 3.)

(10) T: To calculate the mean, sum the values and divide by?

(11) Ss: The number of individuals.

(12) T: This is called the arithmetic mean. How is it calculated? We call the first value as x_1, the second as x_2, the third as x_3. and so on to x_n. Then, sum these values.

(13) Ss: Sum the values x_1 through x_n, then divide by n.

(14) T: Divided by n, we write it as multiply $\frac{1}{n}$. In maths we note the mean value as $\bar{x}$.
(The lesson continued with exercises on calculating the arithmetic mean, including evaluating shooting scores, class average height, and weekly physical exercise times for students.)

This pedagogic practice is observed in a bottom-stream classroom. Although the teacher displays the title 'Analyzing Data – The Mean Value' on a slide (Line 8), she does not immediately transition into the specific details or properties of the mathematical concept. Instead, she begins with an exercise that asks students to calculate a child's average test score, eliciting the rules for calculating the mean from students' responses (Line 10). The formal introduction of the mean begins at Line 10, with prior activities, including Ming's swimming example, considered preparatory.

The structural level

The initial task in the preparation phase is clearly situated within the public domain, as indicated by its weak classification in both content and expression. The task is framed in a specific, context-dependent scenario: 'the neighborhood school in Chang'an district' (Line 1), involving a student named Ming planning to swim in a pond. This localized setting, closely tied to everyday experiences, presents the open-ended and non-mathematical question: 'What safety risks are associated with Ming's idea?' This further emphasizes its basis in practical, everyday concerns rather than academic inquiry. Consequently, the task is more readily viewed as a safety education exercise than as a mathematical one. The mathematical symbols (1.5 and 1.75), embedded within the pond's depth and Ming's height, reinforce the notion that this task belongs to the public domain rather than the esoteric mathematical domain.

In this setting, students are positioned as evaluators, determining the safety of Ming's swimming plan. This role is highly objectified, with students acting as external observers rather than active task participants, which leaves no room to produce their subjectivity.

The textual level

The teacher employs both a limiting message strategy and a particularizing discourse strategy. Initially, the teacher does not introduce esoteric mathematical messages after the Line 24, focusing instead on practical, context-detailed tasks. This approach effectively backgrounds the mathematical content, preventing it from becoming the focal point of instruction. By avoiding additional mathematical symbols or concepts, the teacher constrains the scope of mathematical symbols.

The discourse strategy is particularizing, identified through the metaphorical relationships established between tasks. The teacher begins with the mean depth of a pond and uses this concept to introduce subsequent examples, such as evaluating shooting scores and calculating class average height. The similarity across these examples is the new content 'calculation of the mean value'. The teacher deconstructs this new content into these tasks, making it more accessible to the students.

Overall, the limiting message strategy and particularizing discourse strategy fall the instruction in the space of localizing. By focusing on context-dependent examples and providing extensive background details, the teacher limits the introduction of esoteric mathematical symbols and remain the discourse at a low level of abstraction. Consequently, students are unable to engage with the deeper, abstract principles of the esoteric mathematical domain and remain within a horizontal power hierarchy.

The resource level

The modes in this extract are iconic, though they are conveyed through textual descriptions rather than visual images. These iconic modes, such as 'our Chang'an district,' 'near the school,' 'summer vacation,' 'learning to swim in the pond,' and 'safety risks,' are highly specific and closely tied to students' everyday experiences. As a result, they are context-dependent and geographically limited. The selected textual elements effectively create a vivid, virtual space, enabling students to easily imagine themselves within the scenario. The character Ming is portrayed in a way that could make him resemble a friend or classmate, enhancing the sense of personal relevance.

Students might even relate the scenario to real-life concerns, such as well-known swimming safety risks around their school. Accordingly, this example prompts a spatial shift in the students' perception, placing them as if they were witnessing the event first-hand. The specific and relatable nature of the descriptions anchors students in this constructed scenario, blurring the boundary between their real-world experiences and the classroom setting.

The teacher's subsequent examples also rely on visual codes translated from textual descriptions, conveying specific, limiting messages. This is consistent with Dowling's (1998, 154) assertion that iconic mode 'renders it particularly appropriate for incorporation into strategies which particularize and limit message'. By using detailed and concrete iconic resources, the potential for generalization is reduced, supporting a localizing instructional strategy. This approach results in low-abstraction practices that, in turn, construct a dependent or objectified student position.

Discussion

This study investigated differences presented in the processes of selecting and transmitting pedagogic messages across three school streams, aiming to uncover how class differences are transformed and legitimized within these processes, thus implicitly reproducing social inequality. Three extracts above are provided to elaborate class-based differences in how teachers from different school streams select and transmit pedagogic messages.

The pedagogic practices of 33 teachers were analyzed and summarized statistically, with the results shown in Table 1. As the table illustrates, Chinese mathematics teachers rarely initiate lessons in the expressive domain. Teachers in upper-stream schools exhibit a balanced distribution across the remaining three domains, each comprising approximately 30% of lesson initiations. In contrast, teachers from middle- and bottom-stream schools predominantly initiate lessons from the public domain, where the inclusion of extensive contextual details can obscure mathematical content. Specifically, middle-stream teachers begin 64% of lessons in the public domain, while bottom-stream teachers do so in nearly 50% of their lessons.

Despite these variations in lesson initiation, the study found no significant differences in message strategies across school streams, with most teachers employing expanding strategies. This uniformity suggests that Chinese mathematics classrooms generally adhere to a standardized approach, incorporating esoteric domain messages consistently from the preparation stage to the presentation of new content. This consistency is likely driven by the standardized curriculum and assessment criteria mandated across provinces, which strictly outline lesson objectives and content, thereby limiting pedagogic flexibility.

However, significant differences were observed in discourse strategies. Upper-stream teachers predominantly employ abstracting strategies, using metonymic connections to link tasks logically and intuitively. This approach facilitates students' access to the esoteric domain, aligning with upper-stream mathematics practices. In contrast, middle- and lower-stream teachers mainly use particularizing strategies, which aligns with Dowling's proposition that particularizing strategy is used for students with low ability, translated from their lower social classes. These teachers tend to connect tasks based on tasks' surface similarities, thereby impoverishing the complexity of the mathematical symbolic system. While this method makes content more accessible, it may interrupt students'

Table 1. Descriptive statistics of analysis results across three streams of schools.

Streams of schools	Domains of practice				Textual strategies		Discourse strategies		Strategic space of instruction		
	Esoteric	Public	Descriptive	Expressive	Expanding	Limiting	Abstracting	Particularizing	Generalizing	Fragmenting	Localizing
Upper (11)	3	3	4	1	10	1	9	2	9	2	0
Middle (11)	2	7	2	0	9	2	1	10	2	7	2
Bottom (11)	4	5	2	0	9	2	3	8	3	6	2

access to the esoteric domain, positioning them as 'dependent' or 'objectified.' These strategies reflect implicit assumptions about students' cognitive abilities based on their social background with upper-stream students presumed capable of engaging with abstract discourse, while lower-stream students are considered in need of simplified, context-dependent instruction. As a result, abstract mathematical knowledge is fragmented into multiple tasks through particularizing strategies, limiting lower-class students' participation in esoteric mathematics. These findings empirically support Bernstein's assertion that social class differences are translated into variations in cognitive skills across social groups, which are then mirrored in pedagogic practices, ultimately reproducing social stratification.

Additionally, class differences are evident between the upper and lower streams, while the middle and bottom streams show no significant differences. This pattern aligns with Li's (2016) "土" social structure, which highlights a relatively small gap between the middle and bottom tiers. This may be due to both lower streams are largely composed of students from restricted code backgrounds. The middle stream, predominantly made up of students from migrant families, shares similarities with the bottom stream, as their parents typically work in low-income, manual labour and lack cultural capital. In contrast, only students in the upper stream possess an elaborated code. Teachers select and organize tasks based on their perceptions of students' abilities, reflecting a view that migrant and rural students have similar capacities.

In conclusion, the class-based differences in the differential selection and transmission of pedagogical messages observed in this study align with Dowling's SAM, demonstrating how recontextualization of social class differences plays out during the selection and conveyance of pedagogic messages. Furthermore, this study illustrates how macro social class distinctions are legitimized through micro-level mathematics pedagogy. These insights highlight the need for mathematics teacher training programs that focus on effective task selection and organization to address educational inequities. Due to limitations in data sources, however, teachers' demographic information and personal attitudes during the processes of messages selection and transmission were inaccessible. Future research could explore how teachers' personal backgrounds influence their approaches to task selection and transmission. In-depth interviews could further investigate whether teachers' attitudes towards their methods of task selection and transmission exhibit class-based differences.

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