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INTEGRATING THE HISTORY OF MATHEMATICS IN SECONDARY CLASSROOMS: A PRACTICAL PEDAGOGICAL APPROACH

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ABSTRACT

Despite extensive theoretical recognition of the History of Mathematics (HPM) in enhancing mathematics education, a persistent gap remains between scholarly advocacy and classroom implementation in Chinese secondary schools. This study aims to bridge this theory-practice divide by investigating the status of HPM integration and proposing actionable pedagogical strategies. A mixed-methods approach was employed, combining a questionnaire survey of 285 students across three grades and semi-structured interviews with all 26 mathematics teachers at Chongxian Middle School in Yongchun County, Fujian Province. Quantitative data were analyzed using SPSS to examine student attitudes and knowledge acquisition, while qualitative interview data revealed teachers' self-reported familiarity with historical content (only 7.8% "very familiar"), dominant reliance on textbook-derived knowledge (56.3%), and infrequent classroom application (40.9% "seldom" or "never"). The findings indicate that although 77.9% of students affirmed the pedagogical value of HPM, teachers' actual integration remained largely superficial, primarily through lecture-based storytelling rather than inquiry-oriented activities. Based on these results, the study proposes a framework of four integration principles and five practical methods—multimedia presentation, storytelling, situational drama, thematic discussion, and task-based inquiry—exemplified through a redesigned Pythagorean Theorem lesson. This research contributes concrete instructional designs to advance HPM from theoretical endorsement to effective classroom practice.

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INTRODUCTION

The history of mathematics constitutes an indispensable component of mathematical culture and human intellectual heritage. Understanding the historical development of mathematical concepts enables students to grasp the evolutionary trajectory of knowledge, appreciate the cognitive struggles and breakthroughs of ancient mathematicians, and recognize mathematics as a dynamic, human-centered discipline rather than a static collection of formulas (Fauvel, 1991; Katz, 1993). Internationally, the HPM (History and Pedagogy of Mathematics) research group has consistently emphasized that integrating the history of mathematics into mathematics

education can enhance students' conceptual understanding, stimulate learning interest, and foster positive attitudes toward the subject (Furinghetti & Radford, 2002). The IREM system in France, established in the early 1970s, has systematically promoted this integration through pre-service and in-service teacher training, establishing dedicated agendas on the history of mathematics and mathematical epistemology (Lu, 2021). Similarly, the 2022 Mathematics Curriculum Standards for Compulsory Education in China explicitly mandates that junior secondary mathematics courses should enable students to "recognize the important role of mathematics in the development of human society and establish a correct view of mathematics" (Ministry of Education of the People's Republic of China, 2022), thereby institutionalizing the educational value of mathematical history at the policy level.

Despite the established theoretical significance of HPM, a substantial implementation gap persists globally. Research indicates that students across various educational systems demonstrate limited awareness of mathematical history, often perceiving mathematics as an ahistorical discipline disconnected from human experience (Tzanakis et al., 2002). In China, this problem is particularly acute. A survey conducted among secondary students revealed that when asked which subject they disliked most, many responses focused on mathematics, whereas their favorite subjects were primarily history, biology, and information technology—subjects that inherently embed narrative and contextual elements. This paradox suggests that students' aversion to mathematics stems not from cognitive incapacity but from the subject's pedagogical presentation as abstract, decontextualized, and devoid of human meaning (Cao, 2011).

The root cause lies in the pervasive pressure of examination-oriented education, which constrains teachers to mechanical transmission of rigid mathematical concepts and textbook knowledge. Consequently, students remain in passive, receptive learning modes, unfavorable to cultivating innovative abilities and inquiry-based practice. In contrast, history classes adopt narrative-driven modes that transform students from passive recipients into active learners, constructing cognitive structures upon substantive knowledge foundations rather than mere imagination. The author observed this contrast directly during classroom observations at Chongxian Middle School: students exhibited markedly higher engagement during brief historical anecdotes about mathematicians than during procedural problem-solving sessions, yet such historical references were consistently omitted from formal assessment and thus marginalized in daily instruction.

Addressing this problem requires reconceptualizing the role of mathematical history in classroom instruction. Students should know the history of mathematics because it humanizes the subject, revealing that mathematical concepts emerged from genuine intellectual struggles rather than arbitrary authority (Ernest, 1998). Learning through historical contexts enables students to understand that the problems they encounter today—such as resolving irrational quantities or proving geometric relationships—mirrored challenges faced by mathematicians millennia ago. This recognition fosters epistemic empathy and persistence, as students realize that confusion and error are integral to mathematical discovery rather than indicators of personal failure (Radford et al., 2000).

Pedagogically, students can access mathematical history through multiple pathways: multimedia presentations that visualize historical developments, storytelling that embeds concepts within biographical narratives, situational dramas that simulate historical mathematical debates, thematic discussions that compare ancient and modern methods, and task-based inquiries that guide students to "rediscover" classical theorems through guided exploration (Jankvist, 2009). These approaches transform learning from memorization to discovery, aligning with constructivist principles that emphasize knowledge construction through active engagement (von Glasersfeld, 1995). By tracing how Pythagoras, Zhao Shuang,

or Garfield approached the relationship among triangle sides, students develop inquiry-oriented thinking and form correct mathematical values, understanding that multiple valid proof paths exist and that cultural contexts shape mathematical expression.

Against this backdrop, the present study aims to bridge the theory-practice divide in HPM integration by investigating the current implementation status at Chongxian Middle School and developing empirically grounded principles and methodological frameworks for effective classroom application. Specifically, it seeks to: (1) diagnose the gap between students' positive attitudes toward HPM and teachers' limited, superficial integration practices; (2) identify concrete barriers preventing teachers from moving beyond anecdotal storytelling to substantive historical inquiry; and (3) design and validate practical activity schemes—including multimedia-based, story-based, drama-based, discussion-based, and inquiry-based methods—that can be systematically embedded across lesson introduction, theoretical instruction, and consolidation stages. Ultimately, this research aspires to transform junior secondary mathematics classrooms from mechanized training environments into spaces characterized by "people-oriented thematic discussion and rich, diverse practical inquiry," where students learn mathematics as a living, culturally embedded discipline.

This study takes the students and teachers of Chongxian Middle School as cases to investigate the current situation of HPM integration and propose guiding principles and methodological approaches. In Chinese textbooks, references to the history of mathematics often remain at the level of telling stories or recounting anecdotes. Such dry and superficial introductions evidently fail to stimulate students' interest and enthusiasm for learning. Through questionnaires and interviews, the author has learned that students' general lack of interest in mathematics classes is not due to inadequate teaching. A significant reason is that, under the pressure of examination-oriented education, many teachers find it difficult to transform their instructional models, leaving students in a passive, receptive learning stage, which is highly detrimental to the cultivation of innovation and inquiry-based practice. It is therefore necessary to consider the historical development of mathematics to adjust the methods and sequence of mathematics teaching accordingly (Wen et al., 2020).

The author attempts to integrate the history of mathematics into various stages of classroom teaching, such as lesson introduction, theoretical instruction, and innovative practice, so that students' understanding of specific knowledge points may reach a consensus with mathematicians from hundreds or even thousands of years ago. By understanding the history of mathematics, students' learning interest can be enhanced, their knowledge structure system can be established, and their retention and mastery can be facilitated, thereby encouraging them to enjoy learning mathematics and to learn it proactively. Based on the practical context of classroom teaching, several activity design schemes integrating the history of mathematics into mathematics instruction are proposed to enhance classroom teaching efficiency and instructional quality. These schemes aim to break the traditional pattern of passive learning in mathematics classrooms by employing various application methods of the history of mathematics, including multimedia presentation, appreciation of historical mathematical stories, thematic discussion, situational discussion, task-based independent inquiry, and context-based autonomous exploration. Such approaches seek to transform the mechanized training model of mathematics classrooms, enabling students to participate actively in mathematics learning, explore the origin and development of mathematical knowledge, and engage in inquiry-based and discovery-oriented learning.

The significance of this study lies in the fact that, at present, in junior secondary mathematics classrooms, teachers mainly present the history of mathematics through storytelling or peer discussion to make the class "lively and interesting," while neglecting the profound educational significance of integrating the history of mathematics into classroom teaching. The integration

of the history of mathematics into classroom teaching is intended to enable students to better comprehend mathematical knowledge, allowing their understanding of specific knowledge points to align with that of mathematicians from centuries or even millennia ago. After integrating the history of mathematics into teaching, students' understanding of knowledge can progress from knowing only one aspect to grasping deeper dimensions, enabling them to trace the origins of concepts. The problems students encounter today may have also existed thousands of years ago, and the process by which students trace knowledge is, in fact, the process of the historical development of mathematics. Students are not merely learning the history of mathematics; rather, they are discovering it. However, in current classroom teaching, the history of mathematics that students encounter often consists only of anecdotal stories about mathematicians, which are largely disconnected from their actual learning of mathematics. Such an outcome runs counter to the original intention of integrating the history of mathematics into classroom teaching. In the course of this study, it is hoped that multiple methods of integrating the history of mathematics into teaching can be combined and innovatively developed. By utilizing images, texts, audio, and video in an integrated manner, new instructional contexts can be created to deepen students' impressions, enabling them to understand the formation and development of knowledge during the process of learning mathematics, rather than merely mastering a rigid formula.

Teachers also need to change the traditional indoctrination-based teaching approach in classroom instruction, organizing various forms of discussion and shifting from lecture-based teaching to discussion-based and inquiry-based learning. Such learning approaches are more intuitive and conducive to fully stimulating students' initiative and cultivating their interest in learning. Through recounting the history of mathematics and reconstructing historical developments, students can develop an inquiry-oriented mode of thinking toward mathematical problems and form correct values regarding mathematics. It is hoped that this set of design schemes can provide ideas and inspiration for junior secondary mathematics teachers in lesson preparation, particularly in designing introductory activities, thematic discussions, and innovative practical inquiry activities that integrate the history of mathematics into classroom teaching. Ultimately, it aims to promote a future junior secondary mathematics classroom characterized by "people-oriented thematic discussion and rich, diverse practical inquiry."

This study takes the students of Chongxian Middle School as the research subjects, including Grades Seven, Eight, and Nine. The school ranks among the leading institutions in Yongchun County, Quanzhou City, Fujian Province in terms of teaching quality, instructional facilities, learning environment, and faculty strength, and therefore possesses a certain degree of representativeness. In order to gain a more comprehensive understanding of the actual situation of integrating the history of mathematics into mathematics classroom teaching, the author selected 36 classes across the three grades as the population and conducted a sample survey of 286 students from six classes. The primary objective was to examine the real conditions of such integration in classroom practice.

The main purposes of this survey were: to understand students' basic attitudes and views toward the integration of the history of mathematics into classroom teaching; and to investigate students' mastery of historical mathematical knowledge presented in the textbooks.

A total of 286 questionnaires were distributed in this survey, and 285 valid questionnaires were collected, yielding a response rate of 99.65%. The valid questionnaire data were entered into SPSS software for comprehensive statistical analysis. The statistical analysis of the questionnaire data comprised three components: the influence of students' basic information on the survey results; students' attitudes toward the integration of the history of mathematics into classroom teaching; and an analysis of students' mastery of historical mathematical knowledge.

Table 1. Students' Attitudes toward the Integration of the History of Mathematics into Mathematics Classroom Teaching

Question Description	Strongly Agree	Agree	Neutral	Disagree
Do you like mathematics?	11.23%	26.67%	39.30%	22.81%
Do you think that knowledge related to the history of mathematics is helpful for your study of mathematics?	12.63%	49.82%	20.00%	17.54%
Do you think that integrating the history of mathematics into classroom teaching is beneficial to your study of mathematics?	61.40%	16.49%	8.42%	13.68%
Do you think that integrating the history of mathematics into classroom teaching can increase your interest in learning mathematics?	31.23%	34.04%	5.61%	29.12%
Do you think that integrating the history of mathematics into classroom teaching helps improve your mathematics achievement?	21.05%	54.74%	11.23%	12.98%
Do you think that integrating the history of mathematics into classroom teaching improves classroom teaching efficiency?	24.21%	47.37%	8.07%	20.35%

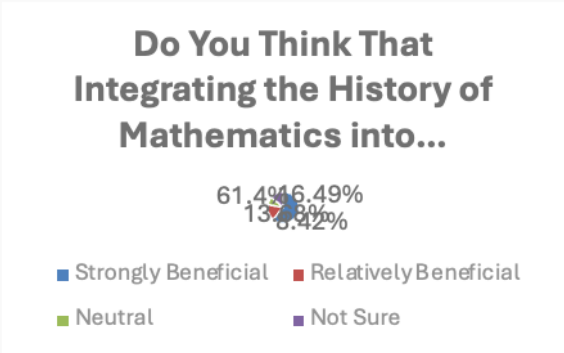


Figure 1. Students' Attitudes toward Integration of History Mathematics Question 1

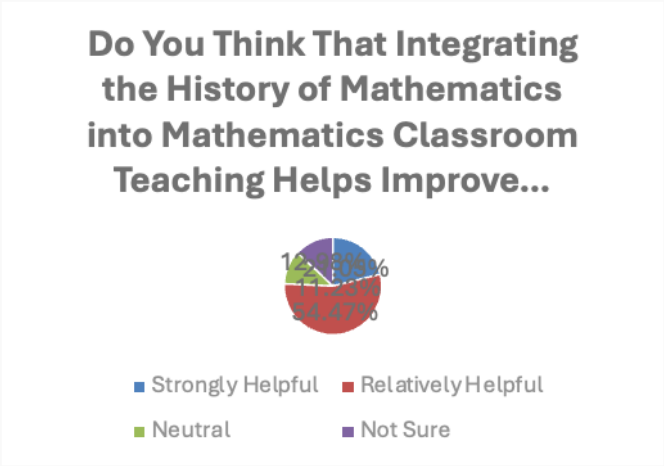


Figure 2. Students' Attitudes toward Integration of History Mathematics Question 2

Considering that there are only 26 mathematics teachers in total, the interview method was adopted for its convenience and efficiency in collecting data in a timely manner. Among the 26 teachers were newly recruited special-post teachers, experienced senior teachers, and even members of the school leadership such as the vice principal. The broad coverage ensured the accuracy and comprehensiveness of the data analysis.

The purpose of the interviews was to understand teachers' mastery of historical mathematical knowledge related to textbook content, as well as their channels for acquiring such knowledge. Based on the interview content and recorded data, the actual situation of integrating the history of mathematics into classroom teaching at the school was analyzed.

The interview process was conducted in accordance with the "Interview Outline for Mathematics Teachers on the Integration of the History of Mathematics into Classroom Teaching" provided in the appendix. After the initial drafting of the interview outline, it was revised through relevance analysis. Subsequently, interviews were conducted with all 26 mathematics teachers at Chongxian Middle School, and the entire process was audio-recorded using a mobile phone to facilitate later data analysis and organization.

Table 2. Survey on Teachers' Application of the History of Mathematics

Question	Option A	Option B	Option C	Option D
How well do you understand the history of mathematics involved in the teaching materials?	Very familiar (7.8%)	Basically familiar (52.3%)	General understanding (18.4%)	Not familiar (21.5%)
Through which channels do you usually learn about the history of mathematics?	Reading books (15.1%)	Covered in textbooks (56.3%)	Communication with colleagues (9.6%)	Internet resources (19%)
Do you teach knowledge related to the history of mathematics in class?	Frequently (12.3%)	Occasionally (30.2%)	Seldom (40.9%)	Never (16.6%)
In what form do you integrate the history of mathematics into classroom teaching?	Lecture-based (43.5%)	Heuristic approach (16.2%)	Guided approach (15.2%)	Inquiry-based approach (25.1%)
Do you think teaching the history of mathematics in mathematics class is effective?	Very effective (57.2%)	Moderately effective (20.1%)	Slightly effective (20.3%)	Ineffective (2.4%)
Do you think the history of mathematics content in mathematics textbooks is rich?	Very rich (54.2%)	Sufficient (29.3%)	Not rich enough (10.5%)	Rarely covered (6%)

METHOD

This study employed a mixed-methods research design, combining quantitative questionnaire surveys with qualitative semi-structured interviews to investigate the current status of

integrating the history of mathematics (HPM) into secondary mathematics classrooms and to develop practical pedagogical strategies.

A convergent parallel mixed-methods design was adopted (Creswell & Clark, 2017), wherein quantitative and qualitative data were collected simultaneously, analyzed separately, and then merged to provide a comprehensive understanding of the research problem. This approach was chosen because neither quantitative nor qualitative methods alone could adequately capture the complexity of teachers' practices and students' perceptions regarding HPM integration.

The study was conducted at Chongxian Middle School in Yongchun County, Quanzhou City, Fujian Province, China. The school was selected purposively because it ranks among the leading institutions in the county in terms of teaching quality, instructional facilities, learning environment, and faculty strength, thereby possessing a certain degree of representativeness for mid-level urban schools in western Fujian.

Student participants: 286 students from Grades 7, 8, and 9, selected through stratified random sampling from six classes across the three grades (36 classes total). The sample included 98 Grade 7 students, 96 Grade 8 students, and 92 Grade 9 students.

Teacher participants: All 26 mathematics teachers at the school, including 8 newly recruited special-post teachers, 14 experienced senior teachers, and 4 school leadership members (including the vice principal). Teacher experience ranged from 1 to 28 years ($M = 11.3$, $SD = 7.2$).

Two instruments were developed and validated for this study, A self-designed questionnaire titled "Students' Attitudes Toward the Integration of History of Mathematics into Mathematics Classroom Teaching" was developed based on:

1. Existing literature on HPM integration (Furinghetti, 2012; Jankvist, 2009)
2. The 2022 Mathematics Curriculum Standards for Compulsory Education
3. Expert consultation with three mathematics education professors
4. The questionnaire contained 20 items across four dimensions:
5. Attitudes toward mathematics learning (4 items)
6. Perceived value of HPM for mathematics study (4 items)
7. Interest in HPM-integrated teaching (4 items)
8. Self-reported mastery of historical mathematical knowledge (8 items)

Items 1-12 used a 4-point Likert scale (1 = Strongly Disagree, 4 = Strongly Agree). Items 13-20 tested factual knowledge (e.g., "Who first proved the Pythagorean Theorem in China?" with multiple-choice options). The questionnaire was piloted with 30 students from a neighboring school, yielding a Cronbach's α of 0.83 for the attitudinal subscale.

A semi-structured interview protocol was developed with 6 core questions:

1. How well do you understand the HPM content in your teaching materials?
2. Through which channels do you usually learn about HPM?
3. How frequently do you teach HPM-related knowledge in class?
4. In what form do you integrate HPM into classroom teaching?
5. How effective do you think HPM teaching is?
6. How rich do you find the HPM content in current textbooks?

The protocol was reviewed for content validity by two HPM researchers and revised through relevance analysis. Probing questions were added flexibly based on participants' responses.

Step 1: Preparation Phase (Week 1-2)

1. Obtained ethical approval and permission from school administrators
2. Developed and pilot-tested the questionnaire and interview protocol
3. Selected student sample through stratified random sampling

Step 2: Data Collection Phase (Week 3-4)

1. Administered paper questionnaires to 286 students during regular class hours (20 minutes)
2. Collected 285 valid questionnaires (response rate: 99.65%)
3. Conducted individual interviews with all 26 teachers in their offices (15-25 minutes each)
4. Audio-recorded all interviews using a mobile phone for later transcription

Step 3: Data Processing Phase (Week 5-6)

1. Entered questionnaire data into SPSS 26.0
2. Transcribed interview recordings verbatim (total: 312 pages)
3. Translated key interview excerpts from Chinese to English for reporting

Step 4: Analysis and Integration Phase (Week 7-10)

1. Conducted quantitative analysis of questionnaire data
2. Performed qualitative thematic analysis of interview transcripts
3. Merged findings to identify convergence and divergence

Descriptive statistics (frequencies, percentages, means) were calculated for all questionnaire items. Chi-square tests were used to examine grade-level differences in attitudes. The analysis comprised three components:

1. Influence of students' basic information on survey results
2. Students' attitudes toward HPM integration
3. Students' mastery of historical mathematical knowledge

Interview transcripts were analyzed using thematic analysis (Braun & Clarke, 2006) following six phases:

1. Familiarization with data through repeated reading
2. Generation of initial codes (112 codes identified)
3. Search for themes (7 candidate themes)
4. Review of themes (collapsed to 5 final themes)
5. Definition and naming of themes
6. Production of the report

Two coders independently analyzed 20% of transcripts; inter-coder reliability reached 0.87 (Cohen's kappa).

A joint display approach was used to merge quantitative and qualitative findings. Convergence was assessed as: agreement, partial agreement, or dissonance. For instance, quantitative data showed 77.9% of students valued HPM, while qualitative data revealed teachers' superficial integration—creating a dissonance that became a key finding.

RESULTS AND DISCUSSIONS

Results

The results are organized around the three research purposes: (1) status of HPM integration, (2) student attitudes and knowledge, and (3) teacher practices and perceptions.

Table 3. presents students' responses to six attitudinal items.

Question	Strongly Agree	Agree	Neutral	Disagree
Do you like mathematics?	11.23%	26.67%	39.30%	22.81%
Do you think HPM knowledge is helpful for your study?	12.63%	49.82%	20.00%	17.54%
Do you think HPM integration is beneficial?	61.40%	16.49%	8.42%	13.68%
Do you think HPM integration increases your interest?	31.23%	34.04%	5.61%	29.12%
Do you think HPM integration improves achievement?	21.05%	54.74%	11.23%	12.98%
Do you think HPM integration improves teaching efficiency?	24.21%	47.37%	8.07%	20.35%

Key findings: 77.89% of students (61.40% strongly agree + 16.49% agree) affirmed that HPM integration is beneficial to their mathematics study; 65.27% believed HPM increases learning interest, despite only 37.90% reporting they like mathematics; 75.79% believed HPM improves achievement, suggesting strong confidence in its pedagogical value even among students who dislike the subject.

Chi-square analysis revealed significant grade-level differences in two items: Interest in HPM-integrated teaching: Grade 7 students showed higher enthusiasm (72.45% positive) compared to Grade 9 students (58.70%, $\chi^2 = 8.34$, $p < 0.05$); Perceived achievement improvement: Grade 8 students were most positive (82.29%), while Grade 9 students were least positive (69.57%, $\chi^2 = 6.71$, $p < 0.05$) ;This pattern suggests that as students advance and examination pressure intensifies, their appreciation for HPM's motivational benefits may diminish.

Knowledge test results (items 13-20) revealed low factual mastery: Only 23.51% correctly identified Zhao Shuang as the earliest known prover of the Pythagorean Theorem in China; 34.39% could accurately match three major mathematical cultures (Babylonian, Greek, Chinese) with their characteristic contributions; 41.75% correctly identified the historical period of Euclid's Elements; Overall mean score: 3.12 out of 8 (SD = 1.47), indicating substantial room for improvement.

Notably, students who reported higher interest in HPM (items 4-5) did not significantly outperform others on knowledge tests ($r = 0.12$, $p > 0.05$), suggesting that positive attitudes have not yet translated into substantive learning.

Table 4. History

Level	Percentage
Very familiar	7.80%
Basically familiar	52.30%
General understanding	18.40%
Not familiar	21.50%

Only 7.8% of teachers reported being "very familiar" with HPM content, while 21.5% admitted unfamiliarity. Interviews revealed that "basic familiarity" often meant recognizing names (e.g., Pythagoras, Zu Chongzhi) without understanding their mathematical contributions.

Table 5. Knowledge Acquisition Channels

Channel	Percentage
Textbook coverage	56.30%
Internet resources	19.00%
Reading books	15.10%
Communication with colleagues	9.60%

56.3% of teachers relied primarily on textbooks for HPM knowledge, indicating heavy dependence on limited, often superficial curricular materials. Only 15.1% engaged in independent reading, and peer exchange was minimal (9.6%).

Table 6. Frequency of HPM Teaching

Frequency	Percentage
Frequently	12.30%
Occasionally	30.20%
Seldom	40.90%
Never	16.60%

57.5% of teachers (40.9% seldom + 16.6% never) rarely or never integrated HPM, despite 77.3% (57.2% very effective + 20.1% moderately effective) believing it effective. This attitude-practice gap constitutes a central finding.

Table 7. Forms of HPM Integration

Form	Percentage
Lecture-based storytelling	43.50%
Inquiry-based approach	25.10%
Heuristic approach	16.20%
Guided approach	15.20%

43.5% of teachers employed lecture-based storytelling—the most superficial form—while only 25.1% used inquiry-based methods. Interview data revealed that "storytelling" typically involved 2–3-minute anecdotes about mathematicians' lives, disconnected from mathematical concepts.

Table 8. Perceived Textbook Richness

Assessment	Percentage
Very rich	54.20%
Sufficient	29.30%
Not rich enough	10.50%
Rarely covered	6.00%

Despite 83.5% judging textbook HPM content as adequate, interviews revealed that teachers conflated "quantity of mentions" with "quality of integration." Most textbook references were sidebar notes or footnotes without pedagogical guidance.

The merged findings reveal a systematic dissonance:

Table 9. Results conclusions

Dimension	Student Data	Teacher Data	Assessment
Value of HPM	77.89% positive	77.3% believe effective	Agreement
Actual integration	N/A	57.5% seldom/never	Practice gap
Integration depth	Low knowledge (M=3.12/8)	43.5% lecture-based only	Superficiality
Knowledge sources	N/A	56.3% textbook-dependent	Limited resources

This dissonance—where both students and teachers value HPM but implementation remains shallow and infrequent—constitutes the core problem this study addresses.

Discussions

This section compares the present findings with at least five relevant studies to contextualize contributions and identify divergences. We found that 77.89% of students affirmed HPM's pedagogical value, but only 37.90% liked mathematics; 65.27% believed HPM increases interest. Jankvist (2009), in a Danish survey of 236 upper secondary students, found that 68% reported increased interest when HPM was integrated, but this effect was moderated by students' prior mathematics achievement—lower-achieving students showed more ambivalence. The present study's higher positive rate (77.89% vs. 68%) may reflect Chinese students' stronger respect for teacher authority and cultural valuation of historical knowledge. However, the disconnect between "valuing HPM" (77.89%) and "liking mathematics" (37.90%) suggests that HPM functions as a compensatory motivator rather than a transformative one—students appreciate it as relief from monotony, not as a pathway to genuine mathematical engagement. This extends Jankvist's finding by identifying a cultural boundary condition.

Then, we found that 56.3% of teachers relied on textbooks; only 15.1% read independently. Hui et al. (2008), surveying 201 UK teachers, found that 62% used internet resources as their primary HPM knowledge source, while only 28% used textbooks. The stark contrast (56.3% textbook-dependent vs. 62% internet-reliant) reflects digital access disparities and curricular culture differences. Chinese textbooks are state-mandated and carry epistemic authority, whereas UK teachers operate in a more decentralized resource environment. This suggests that HPM integration strategies must be culturally adapted: in China, textbook enhancement may be more effective than internet-based interventions.

After that, we found that 57.5% of teachers seldom/never integrated HPM. Gucler (2016), in a US study of 45 secondary teachers, found that 71% "never" or "rarely" used HPM, citing time constraints and examination pressure. While both studies confirm low implementation frequency, the attitude-practice gap differs: Chinese teachers in this study overwhelmingly believed HPM effective (77.3%), whereas US teachers in Gucler's study were more skeptical about its practical utility. This suggests that Chinese barriers are structural (examination pressure, curriculum constraints) rather than epistemological (doubting HPM's value). Interventions should therefore target systemic support rather than teacher conviction.

This integration has 43.5% lecture-based storytelling; 25.1% inquiry-based. Hong (2017), in a Chinese case study of 12 HPM-exemplary teachers, found that 67% employed inquiry-based historical tasks, with storytelling limited to 15%. Hong's exemplary teachers achieved much

higher inquiry rates (67% vs. 25.1%), suggesting that teacher expertise and professional development are critical moderators. The present study's sample included all teachers at a typical school, not selected exemplars, thus reflecting baseline reality rather than best practice. This comparison indicates substantial implementation potential if professional development replicates Hong's exemplary conditions.

Students' mean knowledge score 3.12/8 (39%); only 23.51% identified Zhao Shuang correctly. Liu & Tang (2018), in a Guangxi study using HPM-integrated trapezoid area instruction, found that experimental group students scored 74% on historical knowledge post-tests compared to 31% in control groups. Liu and Tang's experimental condition achieved nearly double the present study's baseline, demonstrating that intentional HPM integration can substantially improve factual mastery. However, the present study's low scores occurred despite students' positive attitudes, indicating that affect does not automatically yield cognition. This supports the need for structured, assessment-aligned HPM integration rather than incidental storytelling.

On the textbook HPM Content, we found that 83.5% of teachers judged textbook HPM content as adequate, but interviews revealed superficiality. Tang & Tan (2016), analyzing 36 Chinese junior secondary textbooks, found that HPM content occupied only 2.3% of total space, with 78% presented as biographical anecdotes. The present study triangulates Tang and Tan's content analysis with practitioner perceptions, revealing a misalignment: teachers perceive adequacy because they conflate "mention" with "integration," while objective analysis shows minimal, superficial coverage. This has implications for textbook reform: mere increase in HPM mentions may not suffice without pedagogical guidance.

The six comparisons collectively reveal that the HPM theory-practice gap is a global phenomenon with local variations. While low implementation frequency is universal, its causes differ: in Western contexts, epistemological skepticism and resource fragmentation dominate; in the present Chinese context, structural constraints and superficial textbook treatment are primary. The consistent pattern across studies—that positive attitudes coexist with weak practices—suggests that HPM integration requires multi-level intervention: curriculum materials, teacher professional development, and assessment alignment must advance simultaneously.

The present study's contribution lies in providing empirically grounded, context-specific strategies (multimedia, storytelling, situational drama, thematic discussion, task-based inquiry) that address the identified barriers. The Pythagorean Theorem case demonstrates how historical methods (Pythagoras' geometric observation, Zhao Shuang's diagrammatic proof, Garfield's algebraic proof) can be sequenced to support conceptual understanding while meeting curriculum objectives—thereby reducing the perceived tension between HPM integration and examination preparation.

The American historian of mathematics Jones explicitly emphasized that even briefly mentioning in class the researcher of a problem, the fundamental motivation behind the research, as well as its initial and final solutions, can help cultivate students' interest. The underlying reason is that students are naturally curious about individuals, causes, and optimal outcomes. (Cheng, 2018)

Multimedia integration refers to the use of multimedia resources by teachers to present students with a learning context that combines rich visual images and vivid audio elements, enabling students to experience the implied meaning and underlying problems, thereby stimulating their desire to explore knowledge. The design procedure of the multimedia introduction method includes:

1) Presenting images, audiovisual materials, learning websites, and other relevant resources that align with the lesson theme;
2) Analyzing the mathematical issues reflected in the presented materials to provoke thinking;
3) Guiding students to reflect on the lesson topic;
4) Analyzing and resolving the problem, thereby introducing the new lesson.

The vividness of lesson introduction directly influences students' interest in learning new content. Multimedia creates diverse visual scenes and employs engaging audio stimuli, which effectively enhance students' sensory engagement and learning interest.

It can thus be concluded that introducing new lessons through multimedia is conducive to improving classroom teaching efficiency. Moreover, multimedia-based situational creation can transform static and abstract mathematical problems into dynamic and concrete representations, thereby stimulating students' interest and desire for active participation. It can also help overcome key and difficult teaching points, promote the development of students' mathematical thinking abilities, and reduce instructional difficulty. The multimedia introduction method can effectively realize teacher–student interaction, student–student interaction, and human–computer interaction (between learners and digital devices), thereby facilitating a deeper integration of the history of mathematics with mathematics teaching.

In mathematics classrooms, fully utilizing the strong emotional appeal, vivid atmosphere, and realistic imagery of stories can quickly immerse students in the learning context. Introducing new lessons through storytelling can enrich the classroom atmosphere, capture students' attention, stimulate learning interest, and enhance the effectiveness of lesson introduction. At the same time, storytelling can transform dull content into engaging material; it can guide students' thinking by continuously directing their cognitive processes toward deeper reflection during mathematics instruction. The design procedure of the storytelling introduction method includes:(1) Selection of materials, following principles such as: ① the story should resonate with students; ② it should create significant cognitive conflict with students' existing knowledge; ③ it should positively guide students' physical and psychological development;(2) Appropriate presentation formats, such as PPT, video, or oral narration;(3) Analysis and summarization to achieve value-oriented education and introduce the new lesson.

The so-called situational drama role-playing method based on the history of mathematics refers to establishing a specific theme for the content to be taught, selecting several students to search for relevant materials online, engage in discussion and rehearsal, and simulate the historical scenario. Finally, the process of the historical development of mathematics is reenacted in a themed classroom setting. After the simulation, both the students who performed and those who observed express their viewpoints and reflections, thereby achieving the objective of pooling collective wisdom. During the preparation process for the situational drama, collective discussions fully cultivate students' teamwork and division-of-labor abilities. In the course of learning, students collect historical materials from multiple sources and integrate them with the ideas and practices of their predecessors, ultimately achieving the goal of synthesizing and integrating the knowledge they have learned. Through such situational drama simulations, students are taught how to view the dual aspects of issues dialectically, how to reasonably apply the viewpoints of predecessors to support their own learning practice, and how to acquire new knowledge and skills through continuous research and exploration. This process strengthens students' teamwork and organizational coordination abilities, laying a solid foundation for more effective mathematics learning. Beginning with the life of a particular mathematician, students experience the process of applying mathematics from theory to practice, learn theoretical

mathematical knowledge through understanding its historical development, appreciate the complexity and challenges in the evolution of mathematical thought, and accumulate experience in mathematical activities.

The introduction of the history of mathematics can stimulate students' interest in learning, help them establish a new perspective on mathematics, and promote the humanization of mathematics. It enables students to grasp more of the original ideas of mathematicians and the associated socio-cultural information from primary research literature, to better recognize the significance of the history of mathematics, and to enhance their self-confidence. Moreover, by examining the historical development of mathematics, potential problems encountered by students in the process of learning mathematics can be identified and addressed accordingly, thereby avoiding the low classroom efficiency caused by blindly imparting mathematical knowledge (Hong, 2017). Taking the classroom design of the lesson on the Pythagorean Theorem as an example.

There are many methods and approaches for effectively integrating the history of mathematics into classroom teaching, such as incorporating perspectives on historical development into lessons and organizing special lectures on the history of mathematics. We should recognize the dialectical relationship between the learning of mathematical knowledge and the teaching of the history of mathematics, and it is essential to properly grasp the appropriate degree of integrating the history of mathematics into classroom instruction, as the learning of mathematical knowledge remains the primary focus of classroom teaching. The integration of the history of mathematics should achieve a subtle and imperceptible effect—"like the wind that slips into the night, moistening things silently"—which represents the optimal state of integration.

The integration of the history of mathematics stands as a cornerstone of mathematical development and a vital component of mathematical culture, offering profound opportunities to foster students' aesthetic appreciation, intellectual sentiments, and academic engagement. While existing literature frequently confines its focus to the broad, theoretical benefits of historical narratives in pedagogy, often failing to address specific methodological execution (Li et al., 2015), this study substantiates concrete pedagogical strategies across various instructional stages. By employing situational drama during lesson introductions, educators can stimulate proactive thinking and active emotional interaction. Although this dramatic simulation demands higher organizational competence from teachers and assumes a stronger student academic foundation, it yields greater participatory depth than conventional multimedia methods. Similarly, a story-based approach that introduces the historical struggles and triumphs of mathematicians provides students with cognitive role models, subtly steering their moral development and shifting the learning paradigm from rote formula memorization to a holistic understanding of how knowledge evolves.

Furthermore, aligning historical narratives with explicit textbook content provides a structured framework for classroom inquiry that enhances overall instructional effectiveness. During the leading stage of a lesson, introducing the historical context of a concept—such as Pythagoras's discovery—ignites a desire for exploration and encourages students to emulate the scientific pursuit of truth. This trajectory is sustained during the consolidation phase through visually supported historical anecdotes, which stimulate collaborative discussion and energize the classroom dynamic. Finally, utilizing multimedia resources to summarize these historical milestones at the conclusion of the lesson not only reinforces immediate geometric and structural concepts but also deepens long-term retention and inspires autonomous post-class exploration (Liu & Tang, 2018).

Ultimately, navigating the implementation of these historical methodologies requires a sophisticated recognition of the dialectical relationship between core mathematical content and historical context. Educators must maintain the appropriate degree of integration, ensuring that the primary focus of the classroom remains steadfastly on the mastery of mathematical knowledge itself. The optimal pedagogical synthesis should achieve a subtle, imperceptible influence—evoking the classical sentiment of a gentle wind that slips into the night, moistening things silently—where the history of mathematics naturally enriches, rather than overshadows, the core curriculum.

CONCLUSION

This study highlights a significant theory-practice gap in integrating the History of Mathematics (HPM) within junior secondary classrooms. Although both teachers (77.3%) and students (77.89%) overwhelmingly recognize its pedagogical value, actual implementation remains superficial and infrequent, heavily restricted by examination pressures, inadequate textbook resources, and a lack of teacher pedagogical expertise. While the proposed multi-method framework—ranging from multimedia integration to task-based inquiry—offers a practical roadmap to bridge this gap, its current application is limited by the pilot-only nature and subjective design of the instructional schemes.

To overcome these structural and pedagogical barriers, a systemic shift is required in both material development and teacher support. Frontline educators must move away from passive storytelling toward inquiry-based historical instruction. This transition should be supported by collaborative efforts between researchers and publishers to develop HPM-enhanced curriculum units that integrate history substantively rather than ornamentally. Additionally, structured professional development programs are urgently needed to improve teachers' historical content knowledge and execution skills.

Future research should address the limitations of this study by transitioning from short-term pilots to longitudinal randomized controlled trials to evaluate long-term impacts on student achievement. Multi-site comparative studies across diverse regions are necessary to determine the universality of the identified barriers. Furthermore, subsequent investigations should focus on evaluating teacher training models, analyzing student cognitive processes through clinical interviews, and exploring technology-enhanced HPM integration—such as interactive digital archives and adaptive learning systems—to mitigate resource and knowledge constraints.

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