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SURVEY PAPER

# Research on mathematics textbooks in relation to curriculum development and instructional reform: recent advances and future directions

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**Abstract**
This paper aims to provide readers with an overview of recent advances in research on mathematics textbooks in relation to curriculum development and instructional reform. It consists of two main parts, with the first part presenting a targeted micro-scoping review of 13 related research articles published over the last decade (2015–2024), and the second part giving an overview of the 13 research articles published in this special issue of *ZDM – Mathematics Education* on the same theme. Overall, the research shows that textbooks serve the important function of not only supporting teachers' instructional practices and change, but also facilitating the rollout or maintenance of new curricula, although how and to what extent mathematics textbooks can play this role depend on a variety of factors, including the design of the textbooks, their alignment with the curriculum changes and pedagogical approaches advocated, and how teachers perceive them. It was observed that while curriculum development can affect teachers' selection and use of textbooks, textbook research can also have an impact on subsequent curriculum reform. Further research is needed to better understand how textbooks can be used effectively in the classroom to support teaching, how professional development can support teachers' optimal use of textbooks, and how the quality of textbooks, especially digital instructional resources, can be evaluated. The paper ends with a discussion of possible future research directions for related issues.

**Keywords** Curriculum development · Digital textbooks · Instructional reform · Mathematics textbook research · Teacher practice · Teacher professional development

## 1 Introduction and background

Textbook research in the mathematics education community has flourished over the last decade or so. That there have been three special issues of *ZDM – Mathematics Education* on mathematics textbooks in the last 12 years is an indication of this. This special issue presents a new effort to reflect such a trend and development in this important area of mathematics education research.

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In research on textbooks, these research objects refer to both traditionally, narrowly defined print copies of books designated for the study of particular subjects (e.g., mathematics) in educational institutions and, more recently, to more broadly defined instructional resources in either print or digital form (Rezat et al., 2021). It should be noted that in mathematics education, not only has the popularity and significance of textbook research been reflected in the growing number of special issues of the journal *ZDM – Mathematics Education* on mathematics textbook research, but also in the fact that five International Conferences on Mathematics Textbook Research and Development (ICMTs) have been organised over the last decade. This conference series is widely recognised as the most comprehensive and influential international conference series devoted to the field of mathematics textbook research and development (Cao, 2022).

With the theme of 'Textbook Research in Mathematics Education', the first special issue of *ZDM – Mathematics Education* for this research field was published in

2013 (vol. 45, no. 5, guest-edited by Fan et al.). With the publication of that special issue, its closely related conference, the (First) International Conference on Mathematics Textbook Research and Development (ICMT-1), was held in Southampton, UK in 2014. This was followed by the second special issue with the theme of 'Recent advances in mathematics textbook research' in 2018 (vol. 50, no. 5; guested-edited by Schubring and Fan), following ICMT-2 held in Rio de Janeiro, Brazil, in 2017. The third special issue featured the theme of 'Mathematics textbooks as instruments for change', which was published in 2021 (vol. 53, no. 6; guest-edited by Rezat et al.), following ICMT-3 in Paderborn, Germany, in 2019. Available evidence shows that these three special issues of *ZDM – Mathematics Education* and the ICMTs, with the first special issue preceding the ICMT conference and the other two following corresponding ICMT conferences, have had a significant impact on textbook research not only in mathematics but also, to some degree, in other school subjects (Cao, 2022; Qi et al., 2024; Rezat et al., 2021).

Following ICMT-4 in Beijing, China, in 2022, this current special issue is a continuation of the three special issues of *ZDM – Mathematics Education* and pushes the agenda further. The theme of this special issue is 'Mathematics textbooks for curriculum development and instructional reform'. There have been many different definitions and categorisations of 'curriculum' from different perspectives and about different educational levels, including, for example, intended curriculum, implemented curriculum and attained curriculum at the national, school and classroom/student level (Fan et al., 2013; Phaeton & Stears, 2017). However, the term 'curriculum' herein refers to the intended curriculum, systemically set and developed learning goals, objectives and content that an education system plans for students to achieve through a period of schooling, and typically reflected in the commonly called curriculum standards, syllabi and/or policy documents at the systemic level, such as the national, state or district level (Mullis & Martin, 2017). Accordingly, by 'curriculum development', we refer to the formulation, revision or maintenance of the intended curriculum; by 'instruction', we refer to teaching practice in the classroom, and we consider 'instructional reform' to be an intentional change process for teaching practice at the school and classroom level, with the aim of improving students' learning (Mitman & Lambert, 1993).

The theme of this special issue has unique value, as the provision and use of textbooks, including broadly defined instructional materials, have critical importance by serving as potential instruments for the implementation of curriculum development at the systemic level and for the realisation of instructional reform at the school and classroom levels. Moreover, not only are the design and writing of textbooks influenced by or based on national or district/school level curriculum policy and documents; after the formation and publication of the textbooks, they can also influence the achievement of the goals of curriculum development and the objectives of instructional reform to varying degrees.

The foci of this special issue are primarily on the topics of how mathematics textbooks are related to mathematics curriculum development and instructional reform in classrooms. It is hoped that the collection of articles in this special issue will make a meaningful contribution to deepening our understanding of the value and function of mathematics textbooks in curriculum development and instructional reform and, ultimately, to improving the quality of mathematics teaching and learning.

## 2 A targeted micro-scoping review of relevant research

To contextualise the papers in this special issue of *ZDM – Mathematics Education*, a targeted micro-scoping review of relevant research was carried out to survey the state of play in researching mathematics textbooks for curriculum development and instructional reform. This targeted micro-scoping review also provides a background for the research foci evident in this special issue. In this context, we posed the following research questions to guide our review:

1. What research on mathematics textbooks and curriculum development, or mathematics textbooks and instructional reform in classrooms has been published over the last decade, i.e., from 2015 to 2024?
2. What have we learned from this research, and what are the research gaps?

The relevant research published in the 10 years before the publication of this special issue (in 2025) had been mapped to give readers an idea of the research trends. This allowed us to identify gaps in mathematics education research on how mathematics textbooks relate to, influence or are influenced by mathematics curriculum development and/or instructional reform in classrooms. Together with an outline of the content of the 13 articles included in this special issue, we offer an understanding of how this special issue extends and enriches current academic knowledge in this line of mathematics textbook research, targeting curriculum development and instructional reform.

A targeted micro-scoping review was selected because it is best suited to the tasks implicated in the research questions listed above. These include mapping the field based on available evidence and identifying research gaps (Munn et al., 2018). There was no need for a critical appraisal of the individual studies identified, nor for a synthesis of the studies gathered—tasks best handled by systematic reviews (Pham et al., 2014)—since the main purpose of our review was not to inform subsequent research studies.

### 2.1 Identifying and extracting data from eligible publications

A search for research publications relating to studies that investigated how mathematics textbooks are related to, influence or are influenced by mathematics curriculum development and/or instructional reform in classrooms was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Moher et al., 2009; Page et al., 2021), which is often adopted for scoping reviews (Stewart & Troup, 2025). This process involved three steps: identifying, screening and including. Figure 1 illustrates the publication selection process.

In the first step, databases and search terms for the literature search were identified. For the former, we surveyed research literature from the ProQuest and Web of Science databases. This decision was based on our understanding that the databases collectively have wide coverage of international research literature. For the latter, we identified the search string "math* AND textbook". This search string might appear too general, but given that this particular subfield of mathematics textbook research is relatively new and unexplored, we decided to "cast a wide net" initially. The number of relevant publications found (see below) justified our choice.

This search string was applied in the first step of the search strategy, identifying. It was applied to both the publication titles and abstracts. This resulted in a total of 3978 publications (regardless of publication year), of which 1401 were identified in the ProQuest database and 2577 from the Web of Science database.

The following five inclusion criteria were then applied in the second step of the search strategy, screening:

(a) Published over the past decade, i.e., from 2015 to 2024 (inclusive)
(b) Peer-reviewed
(c) Full-text articles available
(d) Source types: book chapters, conference papers and proceedings, dissertations and theses, reports, scholarly journal articles
(e) All languages eligible

In this way, 107 publications from the ProQuest database (94 of which were in English) and 31 publications from the Web of Science database (13 of which were in English) were identified. These 138 records were then screened again, and three duplicates were identified, resulting in 135 records.

The 135 titles and abstracts were first perused independently by two of the authors to identify publications that reflected the theme of 'mathematics textbooks for curriculum development and instructional reform'. It needed to be evident in the title or corresponding abstract that the publication was not just mathematics textbook research but was also

contextualised in either curriculum development or instructional reform, using the definitions laid out in Sect. 1. For example, the title "Does the textbook matter? Longitudinal effects of textbook choice on primary school students' achievement in mathematics" (van den Ham & Heinze, 2018) suggests that the research study was about textbooks and students' achievement, rather than with the intended curriculum or instructional practice. As such, it was one of the 122 publications excluded.

The exclusion of 122 publications that did not satisfy the research criteria resulted in 13 publications, of which 11 were in English, and one each was in Spanish and Turkish. This large number of rejections was expected since the search string (i.e., "math* AND textbook") was wide in scope to allow for the capture of a maximal number of publications for individual examination and selection.

Corresponding to the third step of the PRISMA process, these 13 publications were subsequently included in the review process. Each was analysed by one or more of the authors of this paper. An online shared document was created for the authors to add their analysis results, guided by the research questions. The fact that there were only 13 publications on this aspect of mathematics textbook research out of 138 highlights the paucity of relevant research in the last decade or so, thus supporting the rationale for this special issue (see Fig. 1).

### 2.2 Study topics of eligible publications

Addressing Research Question 1, targeting the research on mathematics textbooks and curriculum development or instructional reform in classrooms, we reviewed these 13 publications according to the two perspectives—research about mathematics textbooks in relation to curriculum development and in relation to instructional reforms. Thus, Sect. 2.2.1 reviews the three publications relating to curriculum development (see Fig. 1), whilst Sect. 2.2.2 reviews the other 10 publications relating to instructional reform.

#### 2.2.1 Prior studies relating to textbooks and curriculum development

In the context of textbooks and curriculum development, three publications reflect studies that were conducted in three different cultures: Croatia (Gracin & Matić, 2021), Korea (Lew, 2020) and the United States (Blazar et al., 2020). Curriculum reform is often supported by the publication of textbooks that are aligned with the new curriculum guidelines. Blazar et al. (2020) investigated whether adopting different elementary mathematics textbooks leads to measur-

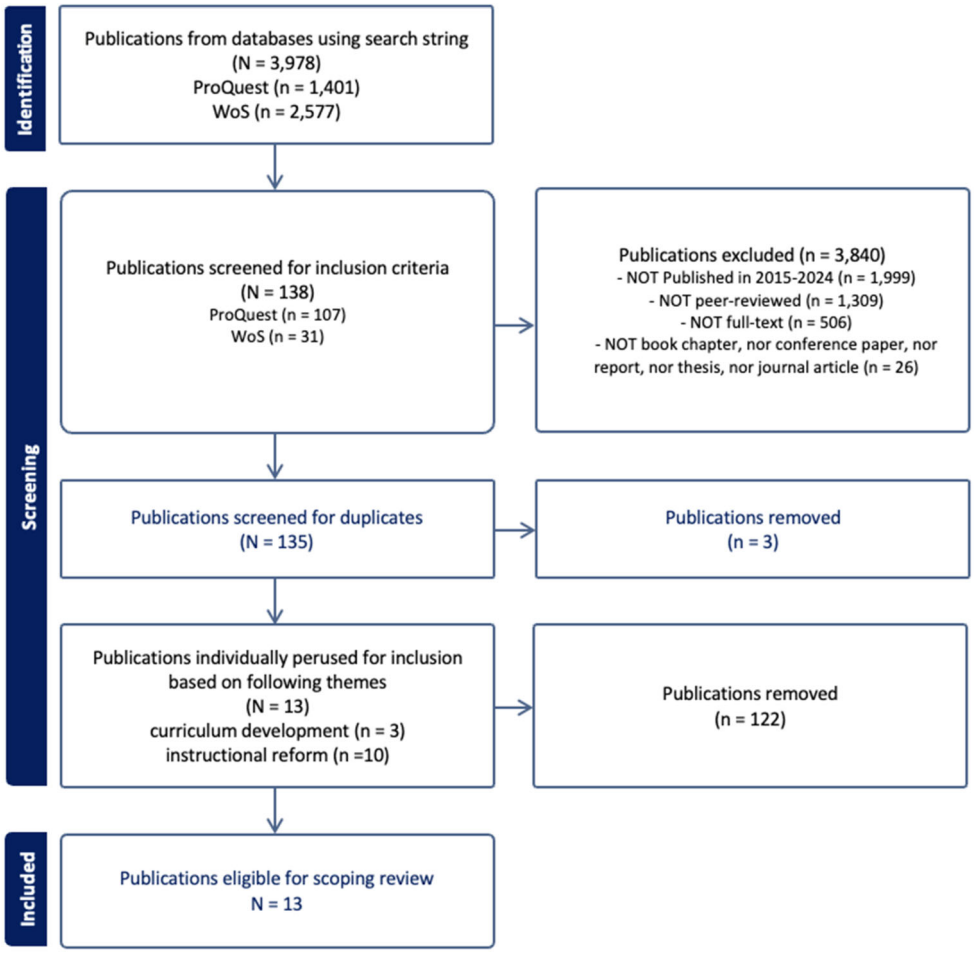


**Fig. 1** *PRISMA Flow Diagram for the Selection of Publications*

able differences in student achievement. The authors articulated two core research questions: First, do average student achievement gains differ meaningfully across schools that adopt different mathematics textbooks aligned with the Common Core State Standards for Mathematics (CCSSM)? Second, is the effect of textbooks consistent across different states in the United States and over time? These questions are situated within the broader policy debate about the extent to which curricular reform—in particular, textbook selection—can serve as a high-leverage strategy for educational improvement.

Curriculum reform can also affect textbook use, as shown by Gracin and Matić (2021). With the implementation of educational reform in Croatia in 2019, the researchers sought to investigate "how the processes of implementing educational reform affect[s] the use of mathematics textbooks… by the teacher and students" (p. 1375). While textbooks were used across all lesson phases in Croatian classrooms, the curriculum reform in the country, which promoted the use of e-resources and digital textbooks, had also changed the way traditional textbooks were being used. For the teachers, the textbook was useful during lesson preparation and for assigning homework to their students. Accordingly, students found themselves using the textbook primarily for completing homework and at home. Faced with choices of learning materials facilitated by the curriculum reform, teachers' and students' decisions were found to be guided by social and institutional parameters, such as norms relating to being a teacher or student. The study also found that "the participating students readily used new digital resources, but if these materials were not interactive or dynamic (e.g., pdf textbooks), they went back to the printed textbooks" (p. 1384).

In the current technological era, it seems natural to ask whether electronic versions of textbooks perform better than traditional print textbooks in supporting curriculum development. A study by Lew (2020) centred on the design, development and implementation of a 'smart' digital mathematics textbook in Korea. The primary research question addressed how digital textbooks—specifically those enhanced with interactive, operation-based learning environments—can transform traditional mathematics education that has historically relied on passive, memorisation-driven teaching methods. The study explored the limitations of existing digital textbook models and sought to demonstrate the pedagogical advantages of an upgraded, interactive version capable

of engaging students more dynamically. The author believed that a smart digital textbook could provide an easy and natural environment where students are encouraged to reflect on their actions. Within this context, the paper identifies key obstacles encountered in prior digital textbook deployments in Korea, such as inadequate authoring tools and limited interactivity, and proposes an improved framework for creating and deploying effective digital mathematics curricula.

Lew's (2020) paper introduced readers to the development process of a digital textbook in Korea, the production of which was a response to a 2012 government policy. 'Client evaluation' was in the form of selected survey feedback from students after they had completed a class on quadratic functions. This highlighted the need for a systematic evaluation of the quality of digital resources, especially given the accelerating growth of digital resources in current times. Indeed, this is a research gap that future related research might aim to address.

While Gracin and Matić's (2021) findings showed that textbook use in Croatia before and after reform was a stable action, professional development emerged as a nonmaterial resource during the curriculum changes. This was in the form of "new teaching approaches within curriculum reform workshops" (p. 1383). It appears that professional development can support textbook use, which then supports curriculum reform. As such, this new factor supporting textbook use deserves to be studied in future research.

#### 2.2.2 Prior studies relating to textbooks and instructional reform

Most of the eligible publications from the screening process—10 out of 13—were studies focusing on how textbooks are related to, influence or are influenced by instructional reform in different mathematics education systems. Some researchers analysed relevant textbooks to investigate their potential to facilitate (or hinder) instructional reform. One example is Pomilio et al.'s (2016) analysis of six popularly adopted Argentinian textbooks to investigate the descriptive statistics activities within them. The assumption is that if textbooks are to facilitate mathematics teaching, the quality of student mathematical activities in the textbook content should be sufficiently high. The researchers carried out a "detailed analysis of cognitive demand, interrelation of concepts and the context of these activities" (p. 1365) as quality indicators. The findings suggested that there was much room for improvement in the Argentinian context. For the topic of descriptive statistics, student activities were assessed as being of low cognitive demand, characterised by low-order thinking and often devoid of context.

There has also been interest in investigating the extent to which technology has been integrated into textbooks, being part of the broader discourse around textbooks' potential to change instructional practice in the current technological era. Mersin and Karabörk (2021) compared Singapore and Turkish middle years (the last two years of elementary and first two years of secondary) textbooks, noting that there had been a "lack of success in integrating technology into learning environments" (p. 553). Although the number of technological tools featured or integrated into textbook content was similar across both countries, Singapore textbooks stood out for their high frequency of calculator use in the textbook content. Technological integration in Singapore textbooks was also found to be in the topics of number and operations, whereas Turkish textbooks tended to feature technologies in geometry and measurement topics. Although the report highlighted Singapore's world-beating performance in international comparative assessments, it ended with a reminder that "the difference in success between these two countries in international comparisons cannot be attributed only to technology" (p. 570).

This knowledge regarding technological integration in textbooks is important, since it is one of the reasons why (Turkish) teachers were found to be using textbooks less when they were teaching online lessons, in an era that sees an increasing number of online (mathematics) lessons around the world. Sevimli (2022) compared Turkish teachers' use of textbooks (versus other resources) in face-to-face and online lessons. The teachers' opinions regarding the usefulness of textbooks in these two modes of teaching were also gathered and analysed. The findings revealed that digital resources were preferred over textbooks in online teaching settings. The research participants advocated for the conversion of textbooks to e-content so that textbook content remains relevant.

In the Chinese educational context, Fan et al. (2021) conducted a study to investigate whether mathematics textbooks, broadly including student books, teacher manuals and exercise books, played a facilitating or hindering role in teachers' teaching and instructional change, as perceived by teachers in Shanghai (Fan et al., 2021). Partly drawing on Shulman's model of pedagogical reasoning and action, the study established a conceptual framework to examine different dimensions of teachers' teaching practices and collected questionnaire data from a stratified random sample of 133 mathematics teachers in 13 secondary schools in Shanghai. Follow-up interviews were also held with 24 of the teacher participants. The results revealed that the textbooks were highly regarded and used by the Shanghai mathematics teachers as facilitators rather than barriers for their teaching and instructional change. The facilitation was most evident in the process of transformation and comprehension and least evident in the teachers' pedagogical reasoning and action. In addition, teacher manuals played a larger facilitating role than student books and exercise books in teachers' teaching. Finally, school characteristics had a greater

influence than teacher characteristics on the extent to which textbooks played a role in facilitating or hindering teachers' instructional practice.

The facilitating role of the textbook was brought into sharper focus in a Japanese study in which Shinno and Mizoguchi (2021) examined teachers' perceptions in the lesson study process. Teacher participants' interactions with the textbook during the '*kyouzai kenkyuu*' process of the lesson planning stage were investigated. The researchers noted that "the unit plans designed by the teachers were based on the textbook chapters without any major changes, but the task and setting (learning trajectory) for the research lessons were changed in different ways" (p. 1400). Yet, such teacher moves are often implicit, and international scholars might not be able to understand what actually takes place in this crucial stage of the research lesson. As such, the study sought to make use of two theoretical frameworks (anthropological theory of the didactic, and documentational approach to didactics) together to present a fuller picture of the teachers' professional moves.

Prior studies examining the role of textbooks in promoting instructional reform were not necessarily triggered by new curricula. Maruyama and Kurosaki's (2021) study in El Salvador, which examined how specially designed textbooks could fill in a "lack of understanding regarding effective teaching of math through textbook development" (p. 834), represented an attempt to support local teaching practice, promoting student engagement in learning through problem solving. The longitudinal study led to the conclusion that local teaching and learning practices have changed, and improved.

Other studies examined the effects of textbooks on particular learning outcomes. Manurung et al. (2020) reported a quasi-experimental study conducted in Indonesia when the government issued new curriculum documents to improve the quality of mathematics education in the country, with one of the important aims being to improve students' mathematical communication abilities. The study aimed to determine the differences in the mathematical communication abilities of two randomised groups of university-level students. The experimental group, consisting of 51 undergraduate students, used textbooks that integrated the Indonesian National Qualifications Framework (KKNI) 6, and the control group, consisting of 49 students, learned mathematics without using textbooks that integrated KKNI 6 tasks. The researchers also investigated whether there were interaction effects of the application of integrated textbook KKNI 6 tasks with early mathematics communication abilities of students to the students' mathematical communication at the end of the study. The results showed that the experimental group of students had significantly better communication skills than the control group; moreover, no interaction effect was found.

Choppin et al.'s (2021) study examined the influence of the features of curriculum materials (mainly textbooks) on teachers' lesson-planning practices. Six United States middle school mathematics teachers using three different series of mathematics textbooks were asked to design lesson plans for the same content area of 'ratio and proportionality', with one lesson plan developed by every teacher for each programme (series). The researchers then conducted interviews with the teachers. Focusing on verb clauses and thematic development, as reflected in the textbooks and in the transcripts of the teachers planning lessons using these textbooks, the study found modest influences of curriculum materials in two ways. First, teachers' lesson plans basically followed the themes and verb use in the textbooks, and second, it appeared that teachers' long-term use of a particular series of curriculum materials had an influence on their uptake of the materials.

Teacher-users of textbooks can adapt textbook content to optimise its relevance and usefulness in their mathematics lessons. Two studies indicated such teacher practices, revealing how teachers' use of textbooks mediates the potential of these resources to realise curricular reform. In the first, Son and Kim's (2015) elementary school teacher participants used either a reform-oriented textbook or a 'traditional' one, so that the researchers could examine how the teachers selected and implemented tasks from the textbooks (and how these influenced the cognitive demand placed on their students). The researchers studied how the teachers selected tasks, modified them (or not), posed the problems and reacted to student responses in a class on fractions. They recommended the use of multiple textbooks to provide a context for teacher learning, providing teachers with the skill to anticipate student thinking (including working from students' misunderstandings) and facilitating discussions on what key pedagogical constructs mean.

The second study, conducted by Webel et al. (2015), investigated how fifth- and sixth-grade mathematics teachers evaluated and utilised web-based curriculum resources to support instruction aligned with the CCSSM. The research is anchored in two overarching questions: First, how do teachers supplement district-provided curricular materials with internet resources to address gaps in CCSSM coverage? Second, what criteria do teachers prioritise when evaluating web-based resources, and how do these criteria shape their instructional decisions? These questions emerged from the contextual shift in U.S. mathematics education, where traditional textbooks are increasingly replaced or supplemented by digital resources, placing greater responsibility on teachers to curate materials that align with rigorous standards. The results showed that teachers used curricular resources widely, and online resources appeared as important as – if not more important than – traditional textbooks. The researchers suggested that teachers need increased opportunities to develop their ability to select online resources wisely.

The findings suggest that in the current digital era, teacher evaluation and use/adaptation of web-based resources in textbooks is an important professional skill.

In summary, our review of research published in the period of 2015–2024 identified 10 studies on how textbooks relate to, influence or are influenced by instructional reform. While the review suggests that textbooks play an important role in facilitating instructional reform, it also indicates that they need to be used in an appropriate way so that the intended benefits aligned with the instructional reform can be realised. Further research is needed to fill the gaps in the understanding of how textbooks can be used effectively to support curriculum development or instructional reform, how professional development can support teachers' use of textbooks, and how the quality of e-resources, including e-textbooks, can be evaluated for their support of curriculum development or instructional reform.

This special issue allows the mathematics education research community to take stock of the latest studies conducted on how mathematics textbooks influence and are influenced by curriculum development or instructional reform. We can evaluate the extent to which the three research gaps identified above have been addressed by the studies featured in this special issue. Readers will also be able to discern whether research in this area is now being conducted by a larger community and what the research trends might look like. To facilitate this, Sect. 3 introduces the special issue articles that relate to mathematics textbooks and curriculum development, and Sect. 4 covers those that relate to textbooks and instructional reform.

## 3 Mathematics textbooks and curriculum development

Among the 13 papers (excluding this introductory paper) featured in this special issue, five relate mathematics textbooks to curriculum development. This will perhaps be welcomed, given that the literature review revealed only 3 of the 13 publications over the last decade were studies on this relationship.

There has been quite a history of this association between mathematics textbooks and curriculum development. It has often been assumed that the printing revolution initiated in 1445 in Europe by Gutenberg was implemented directly for the production of mathematics textbooks. Schubring's (2025) paper on this issue investigates this process more closely, suggesting that it created the precondition for ensuing curricular developments. The characteristics of the first mathematics books printed in Europe were studied regarding their printing styles and compared, in particular, with the traditional manuscript mode. Rather than a radical rupture, it was revealed that the first printers tried to show continuity for typical manuscript styles. Both principal types of mathematics textbooks of the Middle Ages—commercial arithmetic and scientific—were investigated. Schubring discusses the analogous process of the implementation of printing in Islamic civilisation, where the reproduction of manuscript copies has been maintained for much longer. The paper argues that textbooks for teaching eventually launched printing there. It also points out that printing mathematics textbooks as one form of printing media did not just mean a technical innovation but a profound sociocultural process for disseminating knowledge and an essential condition for modernising society. This raises the question of whether the new form of textbooks facilitates the rollout of new curricula and/or of instructional reform differently.

Next, we feature Nakawa and Kosaka's (2025) study of print textbooks. They examined two inquiry-based Japanese high school mathematics textbooks, employing a mixed-methods approach that included both horizontal and vertical analyses to assess their alignment with national curriculum guidelines and their support for inquiry-based learning. This study is situated within Japan's broader educational reforms, which emphasise the integration of inquiry-based approaches to foster critical thinking, problem solving and interdisciplinary connections. The authors found that despite the curriculum guidelines' intention to integrate various subjects, the degree of integration was generally limited in most targeted inquiries and was often confined to a single-subject or disciplinary approach. There were significant gaps between the national curriculum standards and inquiry-based high school textbooks, particularly in terms of subject integration and depth of inquiry. The cross-curricular perspective was not adequately reflected, as many inquiries treated mathematics and statistics as merely instrumental tools. Furthermore, the mathematical scope of these inquiries was narrow, meaning they did not reflect the ideal cross-curricular inquiry-based education outlined in the curriculum. This brings to mind the question of whether inquiry-based pedagogies might be perceived to be at odds with the Confucian heritage traditions that characterise Japanese society. At the same time, this study more broadly reveals a gap between the design of the textbooks, alignment with the curriculum changes and the pedagogical approaches advocated, and discusses how these gaps can be avoided.

Rezat's (2025) study does not focus on physical textbooks; rather, it concerns digital educational resources. The study examined how the quality of digital educational resources was assessed across different educational systems in Germany. There are some intersections with Webel et al. (2015), reviewed above. Rezat analysed quality criteria documents through qualitative content analysis, although only 2 of 16 German federal states had publicly available official documents specific to mathematics education. A total of 17 categories of quality criteria were identified, and they revealed a lack of detailed mathematics-specific requirements.

Many criteria were broad references to didactical principles and educational goals. Referencing these criteria against the mathematics curriculum and comparing them across resources revealed a lack of coherence. The paper concludes with a call for educational authorities to maintain control over the quality of resources utilised in schools, especially in the current age of artificial intelligence. This study focuses on official documents that guide the approval or evaluation of digital curriculum resources (DCRs) for mathematics, drawing the attention of researchers and policymakers to the publishing criteria for DCRs in mathematics, especially detailed quality requirements grounded in research and closely related to mathematics.

Fan et al. (2025) conducted a cross-cultural study in Shanghai, China and Central Java, Indonesia, in which 84 teacher participants completed a questionnaire and some were subsequently interviewed by the researchers. The study examined the interplay between curriculum development (with a focus on teaching strategies, content and assessment) and the role of textbooks in its implementation. While both Chinese and Indonesian teachers found their textbooks to be important in facilitating curriculum development, echoing Gracin and Matić (2021), they valued different aspects of textbooks in supporting curriculum implementation. For the Chinese teachers, it was the content of teaching, whereas for the Indonesian teachers, it was teaching strategies. Potential reasons are discussed in this paper.

Within each country, the study also found that Chinese teachers perceived textbooks' most important role to be reflecting the change in mathematics content, more so than instructional strategies and assessment. Their Indonesian peers felt that the most important role of textbooks was to guide changes in instructional strategies. This difference is discussed in the context of Chinese curriculum reform, although it was not clear from the paper why the Indonesian teachers felt the way they did. It would be interesting to know whether the geography of Indonesia, being the world's largest archipelagic country, posed logistical and other challenges to teacher professional learning programmes, so that teachers placed more emphasis on the textbooks as a source of information about teaching strategies.

While the papers above highlight how textbooks responded or conformed to expectations arising from curriculum development, Pang and Lee (2025) demonstrate how research into textbooks also impacts the development of such documents. Their study focuses on how mathematics textbook research impacts subsequent curriculum development in Korea and how mathematics textbooks are developed according to the revised mathematics curriculum. The study specifically refers to the equal sign and equivalence relationship, which was added to the Korean mathematics curriculum in 2022. This inclusion involved the reorganisation of both content and pedagogy. For the former, the definition of the equal sign was extended to highlight the relational meaning. The curriculum also listed supporting pedagogies—that is, using equations with a variety of structures and phrasing tasks so that student readers had to reason about the relationships between both sides of an equation. It is interesting to note that textbook research can function both as a practical mechanism for translating curricular intent into instructional activities and as a catalyst for curriculum development.

## 4 Mathematics textbooks and instructional reform

The other eight papers in this special issue focus more on the roles of mathematics textbooks in facilitating and supporting different aspects of instructional reform. Pepin et al. (2025) examined how the lesson planning capacity of 16 pre-service mathematics teachers in Norway was facilitated by two textbook series. The findings showed that providing preservice mathematics teachers with commonly used reform-oriented textbooks or teacher guides was insufficient. They needed more support in terms of (a) types of reasoning and proving in different mathematical areas and tasks, and (b) elaborating lesson plans, considering all aspects of lessons (e.g., aim, activities, assessment, student thinking and misconceptions, teacher role). The study argued that lesson planning was viewed as a form of curriculum development, with textbooks and other resources playing a key role in translating curricular goals into actionable lesson plans and classroom practices. The research bridges the theoretical aspects of curriculum resources with their practical application, analysing how teachers interact with these tools to align their lessons with new curricular objectives.

Qi et al.'s (2025) paper also focuses on how textbooks support new instructional practices. In particular, they explored how Chinese secondary mathematics teachers engaged with textbooks during lesson study when designing project-based lessons. Drawing on the framework of curricular noticing, the study focused on teachers' attending to, interpreting and responding to textbook content for project-based learning (PjBL). Data were collected from the lesson study group through video recordings, interviews and instructional artefacts. The authors found that teachers generally began by identifying and discussing core textbook elements, especially mathematical tasks, and then interpreted these elements in relation to PjBL goals, often recontextualising them to better fit students' learning needs and the collaborative nature of projects.

While the teachers valued the textbook as a key resource, they often had to modify its structure and integrate multiple parts to create coherent project tasks. This process was shaped by both collective negotiation within the lesson study

and individual pedagogical commitments. Notably, the textbook's conventional format—centred on standard exercises and structured content—was sometimes perceived as misaligned with the open-ended, exploratory nature of PjBL. The findings highlight the importance of professional learning environments that support teachers in developing curricular noticing capacities, particularly in adapting traditional materials to innovative instructional formats like PjBL. The theoretical contribution of this study relates to highlighting curricular noticing as a key construct in understanding how teachers engage with curriculum materials during reform-oriented pedagogies.

The above references to the importance of textbook content quality, including how it is aligned (or not) with intended instructional practices, are echoed by many of the studies featured in this special issue. Dröse et al. (2025) examined the extent to which strong and weak material support facilitated teacher implementation of instructional innovations for word problem comprehension strategies. The teacher participants received the same professional learning on explicit instruction prior to teaching the word problem comprehension strategies. In the strong material support condition, teachers received curriculum materials in which the components of strategy instruction were explicitly integrated. In the weak material support condition, the curriculum material only printed the sequence of word problems, but the teachers had to implement explicit strategy instruction themselves. The findings indicated that strong material support led to more learning opportunities for students and higher measurable student strategic learning gains, while weak material support led to varied learning opportunities.

Wang and Leung (2025) focused on the connections within the mathematics content being presented. Utilising concept maps and social network analyses along with adjacency matrices and directed graphs, 12,062 connections were identified in 3843 problems on the topic of 'equations' in mathematics textbooks from Australia, China, Singapore, the United Kingdom and the United States. A comparative framework based on the perspectives of the connections was proposed and applied to compare the difficulty of the topic 'equations' as it was presented in the textbooks chosen. The results revealed that the Singapore textbook series was the most difficult, followed by those from China, the United Kingdom and Australia, with the United States last. Additionally, the framework offers an approach to assessing whether the content of a particular textbook is appropriately challenging for students, potentially identifying learning obstacles. It not only supports students in mastering complex concepts but also equips teachers with a deeper understanding of the resources they utilise, ultimately contributing to improved educational outcomes in mathematics. In many ways, the research reported in this paper connects well with a recent paper by Li and Fan (2024), which demonstrates how a Chinese textbook and a United States textbook emphasise within-concept and between-concept connections differently. The research process and findings of this study highlight the importance of connections within mathematics textbooks and argue that when textbooks contain richer connections, they provide more comprehensive support and resources for effective classroom teaching. This has significant implications for the development and evaluation of mathematics textbooks.

Beyond optimising the quality of textbook content, mathematics textbooks' facilitation of instructional reform can also benefit from supporting teachers' effective use of this content. Such a need is evident in Hwang et al. (2025), for instance. They conducted a study in the United States on the role of textbooks in catalysing instructional change through problem-posing based learning. As part of a longitudinal project, the study analysed the *Illustrative Mathematics* curriculum and observed three teachers to explore the presence and use of problem-posing tasks. This study also raises the viewpoint that any curriculum reform that depends on changing teachers' instruction (such as P-PBL) must take place in very small increments. Tight-knit pedagogical and mathematical decisions underlie each component of a high-quality lesson, and attempting to make a large change while maintaining that coherence is surprisingly challenging.

Similar—if not greater—levels of support should be offered to teachers if digital textbooks are deployed. Gracin and Trupčević (2025) explored the role of digital textbook tasks in Croatia's middle school mathematics classrooms in the context of national curriculum reforms that emphasise the integration of interactive, feedback-driven and context-based digital learning tools. Using a mixed-methods approach, the study analysed 3363 e-tasks from three digital textbooks and observed six mathematics teachers' lessons to investigate how the digital tasks were utilised in classrooms and how they supported or hindered instructional goals. The findings revealed a significant gap between the design potential of these digital tasks and their actual use in classrooms. Although many tasks featured interactivity and real-world relevance, teachers rarely used these elements; instead, they treated digital textbooks as static presentation tools akin to printed versions. Barriers such as limited professional development, inconsistent access to technology, and students' varying levels of digital literacy were identified as key constraints. Moreover, the study noted that digital textbooks act as an intermediate variable between the curriculum and classroom practice and may serve as instruments for change, but not all digital potentials outlined in the curriculum were incorporated into the digital textbooks, and even fewer were utilised in classroom settings.

Thus, even though digital textbook tasks have the potential to transform mathematics instruction by fostering active learning and critical thinking, the realisation of this potential

requires systemic support for teachers, particularly through professional development, infrastructure improvements and ongoing evaluation of digital resources. The study also emphasises the importance of aligning digital textbook design with actual classroom practices to ensure that curriculum reforms lead to meaningful instructional change.

These considerations remind us of the importance of evidence-informed textbook development processes that consider not only the recommendations and requirements of the relevant mathematics curricula but also the experiences and suggestions of stakeholders. We see an example of this in Liu et al. (2025). Their research retrospectively studied the development of the fifth edition of a textbook series written for six elementary grades in China. The new edition was produced to complement the 2022 release of the updated Chinese mathematics curriculum. Three chief editors, 12 editors and 44 members of the textbook research team took part in the participatory action research involving semi-structured interviews, informal conversations and document analyses. Through a detailed account of the research conducted, three unique features of the textbook development process were identified: a comprehensive writing and revision process, the involvement of as many stakeholder groups as possible in sourcing suggestions and contributions, and a validity verification system for writing and revision.

This study offers a critical analysis of contemporary methods and challenges in Chinese textbook development. It also proposes an evidence-based textbook development pattern that could inspire future research in the field of mathematics textbook development. However, as we are reminded by Chen (2013), teachers in China, like their colleagues overseas, possess different conceptions of textbooks. School and mathematics teachers' beliefs and values with regard to textbook use should continue to play an influential role in shaping how mathematics textbooks are used (Gracin & Matić, 2021; Jamieson-Proctor & Byrne, 2008).

Amid the many considerations of how textbooks can better facilitate and support instructional reform, we should also take a step back to contextualise where all these considerations came from. Višňovská and Cortina (2025) provide a specific cultural example. Their study contributes to raising awareness and understanding of the tensions between two influences that have been shaping the design of textbooks and other teaching resources through a specific content illustration. The paper features a textual analysis of elementary school curricula from Australia and Mexico, documenting a curricular trend in which numbers are framed almost exclusively in terms of counting, while measurement—as an additional source of number meaning—is largely neglected. The authors argue that this trend acts against instructional designs that aim to introduce whole numbers, fractions and decimals as numbers developed from the same conceptual foundation and with coherence for the learner. An analysis of relevant literature showed that this trend and the resulting tensions are rooted in curricular decisions made during the New Math movement in the United States in the 1960s, and which remain common across Western mathematics curricula. The paper offers alternatives to current curricular conceptualisations of mathematics that could provide guidance in developing future curricula that better supports coherent mathematics instruction.

## 5 Summary and concluding remarks

The targeted micro-scoping review of relevant research presented earlier in the paper shows that there has been more active mathematics textbook research in relation to instructional reform than to curriculum development, with research involving digital textbooks also being evident. The review identifies a need for further research on how textbooks are and can be used in the classroom to support teaching, how professional development can better support teachers' use of textbooks, and the need for approaches to systematic evaluation of the quality of digital textbooks and related resources.

While textbooks support teachers' pedagogical practice in the classroom directly and indirectly, the articles featured in this special issue collectively convey the message that textbooks also facilitate the rollout of new or revised curricula and the introduction of reform instructional strategies, although how and to what extent mathematics textbooks can play a facilitating role depend on a variety of factors. These factors include the design of the textbooks, their alignment with the curriculum changes and pedagogical approaches advocated (Nakawa & Kosaka, 2025), and how teachers perceive them (Qi et al., 2025). A few of these articles also demonstrate how textbook research can influence subsequent curriculum reform (Fan et al., 2025; Pang & Lee, 2025; Višňovská & Cortina, 2025).

A common message is that there is a need for relevant professional development to support teachers' optimal use of the textbook resources (Dröse et al., 2025; Wang & Leung, 2025), including making full use of the interactive activities featured in digital textbooks. Such teacher support is recommended across the entire process of teaching planning, lesson delivery and learning assessment (Pepin et al., 2025). Specific skills support includes sharpening teachers' skills in curricular noticing (Qi et al., 2025), content knowledge acquisition (Pepin et al., 2025) and textbook content elaboration (Pepin et al., 2025). The need for relevant professional development is also one of the research gaps identified in the scoping review.

The articles in this special issue also highlight recent research that addresses the other research gaps identified in the scoping review. For example, Rezat's (2025) paper provides an example of how the quality of digital resources can

be assessed, a research gap identified by Lew (2020). Fan et al.'s (2025) report reveals how teachers focus on different aspects of textbook content to support their respective practice, which addresses a research gap identified by Gracin and Matić (2021). As Fan et al. (2025) involved teachers in China and Indonesia, whereas Gracin and Matić (2021) worked with teachers in Croatia, it should be noted that cultural differences might also mediate teachers' professional use of textbook content in their respective professional settings.

While the digitalisation of textbooks and digital textbooks in recent years have been increasingly popular, a bigger disruption could arise from the 'textbooks X artificial intelligence (AI)' phenomenon. AI-enabled textbooks can, for example, support us in better catering to individual students' learning styles and needs. Initiating and engaging in more research into mathematics textbooks in their various formats (print, digital and AI-enabled), informed by the knowledge and wisdom we have accumulated from current and past (mathematics) textbook research, would be instructive (Gracin & Trupčević, 2025; Rezat, 2025).

Print newspapers have been a source of news and information globally for more than four centuries. In the 21st century, people receive their news through other media, such as social media, which is interactive and is often updated as events happen. At the same time, print media have been adapting to these developments as it seeks to stay relevant. Many broadsheets and tabloids now have online versions whose content is updated by the minute, and which allow website visitors to interact with news that has been published online. Will traditional textbooks face a similar kind of challenge from digital and AI-enabled resources in the forms of websites, software programs, adaptive software and interactive programmes? As different forms and variants of textbooks become available—and hopefully, more readily so and in more equitable ways—will they be distinguished by how they facilitate the rollout of new curricula and/or instructional reform (Schubring, 2025)? If core values are effectively represented through the 'traditional' form of print textbooks (Mutlubaş & Şahin, 2022), can these values be conveyed through the alternative forms as well? Also, are all these forms and variants of textbooks equally effective in developing learners' mathematics competencies, given the increased importance of these capabilities alongside knowledge and skills (Hwang et al., 2025; Seah, 2025)? There are indeed many more opportunities for new research work with textbooks (in their various forms) evolving in the rest of the 21st century, and possibly beyond.

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## Declarations

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