

How teachers' reading of competency-oriented national mathematics curriculum documents relates to their sense-making of reform messages

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Received 17 February 2024 ▪ Accepted 17 May 2024

Abstract

Although implementing a competency-oriented national mathematics curriculum is a global trend, limited studies have explored how teachers read their national mathematics curriculum documents and make sense of the competency-oriented reform messages present in these documents. This study investigated the patterns of teachers' reading of the competency-oriented national mathematics curriculum documents and how the reading relates to the teachers' sense-making of the reform messages in the documents. Participants included 18 in-service mathematics teachers who took part in a graduate course designed to support interpreting the recently revised competency-oriented national mathematics curriculum documents in Korea. Content analysis of the teachers' writings regarding their interpretations of the documents revealed three types of reading: *identifying*, *clarifying*, and *extending* competency-oriented curriculum messages. Reading accompanied by 'clarifying' formed a *dialogic relationship* between the teachers and the curriculum, leading to *accommodation* of competency-oriented messages. Conversely, reading accompanied by 'identifying' but without 'clarifying' led to a *monologic relationship* between the teachers and the curriculum, resulting in the *assimilation* of competency-oriented messages. We conclude by suggesting that teachers' nuanced interpretations of competency-oriented national mathematics curriculum documents may contribute to professionalism in handling the curriculum.

Keywords: mathematical competency, national mathematics curriculum documents, educational policy sense-making, curriculum reading, participatory relationship

INTRODUCTION

Traditionally, the predominant focus of school mathematics education has been static knowledge, emphasizing memorizing and mastering facts and techniques (Schoenfeld, 1994). However, within the field of mathematics education, a notable shift towards broader considerations of mathematical competency, encompassing mathematical thinking, creativity, and application, has occurred in recent decades (Lithner, 2008; National Council of Teachers of Mathematics [NCTM], 2000; Niss & Højgaard, 2019). This paradigm shift has spurred reform efforts in mathematics education, as revised curriculum is increasingly used as a pivotal tool for effecting such reform. Specifically, interest in developing and implementing a competency-oriented mathematics curriculum at the national level is also increasing (Niss et al., 2016).

However, merely developing a curriculum does not necessarily ensure changes in classroom practices (Anderson et al., 2012). Research has highlighted the misalignment between the intentions for competency-oriented national curricula and actual classroom practices (Boesen et al., 2014; Dolma et al., 2018; Prendergast & Treacy, 2018; Sunzuma & Luneta, 2023). Factors influencing these misalignments extend beyond environmental ones, such as school culture (e.g., März & Kelchtermans, 2013), available resources (e.g., Stein & Kaufman, 2010), and the support provided to teachers (e.g., Hajer & Norén, 2017). Researchers have explored teachers' sense-making of messages within their competency-oriented mathematics curricula (e.g., Bergqvist & Bergqvist, 2017, 2020; Boesen et al., 2014; Bümen & Holmqvist, 2022; Højgaard & Sølberg, 2023). For instance, Boesen et al. (2014), in their analysis of teachers' comprehension of competency-oriented reform

Contribution to the literature

- By investigating the interaction between teachers and national curriculum documents, this study elucidates the relationship between teachers' reading patterns and their sense-making of competency-oriented reform messages.
- This study broadens knowledge of current literature by refining teachers' perceptions regarding mandated aspects of the national curriculum, which are known to be integral to their competency in managing the national curriculum.
- By examining how teachers extend their understanding of competency-oriented curriculum messages, this study illustrates how teachers could benefit from integrating national curriculum documents into their curriculum resources.

messages in Swedish national mathematics curriculum documents, observed that many teachers had a reasonable but superficial understanding of the intended messages. Similarly, other studies have found that teachers struggle to accommodate competency-oriented curricula messages (e.g., Bergqvist & Bergqvist, 2020; Bümen & Holmqvist, 2022), which suggests that these challenges may hinder the implementation of competency-oriented mathematics education.

In response to these challenges, Boesen et al. (2014) proposed providing teachers with opportunities to read competency-oriented national curriculum documents to enhance their understanding. However, the assumption underlying Boesen et al.'s (2014) proposal—that reading leads to understanding—is not straightforward and merits careful examination. While the importance of reading national curriculum documents has been supported by both theoretical studies of teachers' curriculum knowledge or competence (Petrou & Goulding, 2011; Tran & O'Connor, 2023; Watson, 2001; Zhang & Stephens, 2016) and empirical studies examining the use of national curricula (Grave & Pepin, 2015; Kaur et al., 2006; Misfeldt et al., 2019), attempts to clarify the relationship between reading and understanding national curriculum documents are rare. In one exception, Bergqvist and Bergqvist (2017) view national curriculum documents as "objectively given structure[s]" (p. 154) and suggest that clear descriptions of competency-oriented messages are necessary to facilitate teachers' understanding by strengthening the link between reading and comprehension. However, according to Remillard (2005), considering not only the structural aspects but also the processual aspects of a text can offer a deeper understanding of the relationship between reading and understanding. Building upon the current knowledge about teachers' competence in handling national curriculum documents (Tran & O'Connor, 2023; Zhang & Stephens, 2016) and their reading process of the curriculum (Hodge, 2023; Remillard, 2005), the aim of this study was to provide new insights into the relationship between reading and understanding competency-oriented national curriculum documents.

Against this backdrop, we investigated the patterns of teachers' reading of the recently revised competency-oriented national mathematics curriculum documents in Korea and how they relate to their sense-making of the reform messages in the documents by addressing the following research questions:

- RQ1.** How do teachers read the competency-oriented national mathematics curriculum documents?
- RQ2.** What is the relationship between teachers' reading of the competency-oriented national mathematics curriculum and their sense-making of the competency-oriented reform messages?

Our exploration of these questions is not only a response to the call from Boesen et al. (2014) but also a complement to the work of Bergqvist and Bergqvist (2017). The analysis may provide insights that bolster the feasibility of implementing competency-oriented mathematics education. Additionally, while this study was conducted within the Korean context, the global trend towards competency-oriented mathematics education reform (Cai & Howson, 2013; Niss et al., 2016) underscores the broader relevance of our findings.

BACKGROUND

In this paper, the term "curriculum" encompasses both the intended curriculum, as articulated in official documents and materials, and the perceived curriculum, reflecting teachers' interpretations (van den Akker, 2013). The focus of this study is the exploration of national curriculum documents—which specify formal objectives, content, and teaching methods (e.g., Hemmi et al., 2021)—and the perceived curriculum. This section provides an overview of trends in competency-oriented national mathematics curricula in an international context and the context of Korea, followed by a review of the literature on

- (a) teachers' sense-making regarding competency-oriented national curricula and
- (b) teachers' reading and use of their national curricula.

Competency-Oriented Mathematics Curriculum Reform

Niss et al. (2016) characterized the educational objectives of reformed mathematics curricula worldwide as incorporating competency-related constructs such as mathematical processes, practices, proficiency, and literacy. These curriculum revisions are grounded in extensive efforts to conceptualize mathematical competency or related constructs. For instance, NCTM (1980) in the United States advocated for including problem-solving, as it is a crucial component of school mathematics beyond factual knowledge and skills. Subsequent reports by NCTM (1989, 2000) broadened the scope of the process aspects of mathematics to include problem-solving, communication, reasoning and proof, connections, and representations. Similarly, the United States National Research Council (NRC) proposed a multifaceted concept of mathematical proficiency comprising conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition (NRC & Mathematics Learning Study Committee [MLSC], 2001). Denmark's KOMPIS project contributed to this discourse by defining mathematical competency as "insightful readiness to act appropriately in response to a specific sort of mathematical challenge in given situations" (Niss & Højgaard, 2019, p. 14) and delineating its components. Moreover, program for international student assessment mathematics framework of 2022 (Organization of Economic Co-Operation and Development [OECD], 2023) includes mathematical reasoning and problem-solving processes as aspects of mathematical literacy within assessment schemes. While perspectives on the constituents of mathematical competency or related constructs may vary, they collectively transcend the traditional emphasis on factual knowledge and procedural mastery (Niss et al., 2016).

Korea has recently revised its national mathematics curriculum, aligning with these discussions on mathematical competency while considering the nation's local context. Competency as an explicit curriculum goal in Korea began with revisions in 2015 (Lee et al., 2018), followed by further revisions in 2022. Competency orientation in the '2022 revised mathematics curriculum' (Ministry of Education [MOE], 2022) is reflected in its goals, content, and methods (Lee et al., 2021). Regarding goals, the curriculum presents mathematical competencies encompassing problem-solving, reasoning, communication, connections, and information-processing. Simultaneously, the definition of 'content' extends beyond static knowledge to include process and attitude elements. Consequently, the content framework is structured into three categories—knowledge and understanding, processes and skills, and values and attitudes—to demonstrate a holistic perspective of competency.

Additionally, the achievement standards were formulated based on the elements of these three content categories to align with the competency orientation. Finally, the national curriculum documents include instruction and assessment methods for teachers aiming to implement competency-oriented mathematics education.

Teachers' Sense-Making of Competency-Oriented Mathematics Curriculum Reform

This study draws on the sense-making perspective, which offers one way to examine educational policy enactment (Datnow & Park, 2009). From this perspective, policy is implemented through the interpretation and responses of stakeholders, with local adaptations of policy inevitable and potentially beneficial (Datnow & Park, 2009). Therefore, how teachers experience and construct meaning from educational policies is a critical factor in policy realization (Fullan, 2015). Previous research indicates that teachers' existing knowledge and orientations shape the ways in which they make sense of policy; moreover, their sense-making influences their decision-making and practices (Coburn, 2004; Gregoire, 2003; Hill, 2001; März & Kelchtermans, 2013; Spillane et al., 2002).

For teachers, making sense of policy messages in curricula involves assimilation and accommodation (Gregoire, 2003; Spillane et al., 2002). *Assimilation* entails understanding the policy within existing frames, whereas *accommodation* involves restructuring existing frames to understand the policy (Piaget, 1972; Spillane et al., 2002). For teachers to change their existing practices, their understanding must move beyond assimilation to the level of accommodation (Gregoire, 2003). Additionally, researchers have found that teachers exhibit non-incorporation reactions, whereby they do not integrate policy messages into their existing frames (Coburn, 2004; Luttenberg et al., 2013). For instance, Coburn (2004) found that teachers make sense of policy messages by either rejecting revisions that conflict with their existing beliefs, offering symbolic responses to revisions that have no tangible effect on their actual teaching practices, or maintaining parallel structures of teaching methods between existing and revised approaches.

Prior studies have further elucidated teachers' sense-making of their competency-oriented national curriculum. First, while teachers acknowledge the value of competency orientation in the national curriculum (Bümen & Holmqvist, 2022; Davis et al., 2013; Graybeal, 2010), they often do not demonstrate a deep understanding thereof. Bergqvist and Bergqvist (2020) found that, among 187 teachers, 99 (53.0%) understood problem-solving as a competency goal by interpreting 'problems' in a commonsense manner (i.e., all types of tasks), indicating an understanding closer to assimilation than accommodation.

Bümen and Holmqvist (2022) observed that teachers in Turkey and Sweden responded to their competency-oriented national curriculum with assimilation or parallel structures; however, they did not find any teachers who responded with accommodation. Boesen et al. (2014) found that Swedish teachers primarily assimilated competency-oriented reform messages, with accommodation being rare. The teachers who assimilated reform messages sometimes engaged in filtering, wherein the interpretation of the messages that aligned with the teachers' subjective frameworks deviated from the intended meaning of the national curriculum. These studies demonstrate that the recognition of the value of competency-oriented reform does not necessarily imply a deep understanding; they also underscore the need to support teachers in accommodating competency-oriented reform messages.

Second, teachers' sense-making of competency-oriented curriculum messages is associated with how the messages are presented in the national curriculum documents. Bergqvist and Bergqvist (2017) argue that clarifying the meaning of competency goals in a national curriculum can assist teachers in their understanding. Their analysis revealed that descriptions of competency in the Swedish national curriculum were ambiguous, and such ambiguity could be one of the causes of some teachers' superficial understanding of competency-oriented messages. KOMPIS project in Denmark (Højgaard & Sølberg, 2023) proposed avoiding syllabus-focused curriculum development and suggested incorporating a framework into a national curriculum that allows teachers to establish relationships between subject matter and competency goals more easily and flexibly. These studies emphasize strategies to enhance teachers' understanding of their competency-oriented curricula by focusing on textual aspects. Conversely, the studies to be reviewed explored the interactions between teachers and curriculum texts.

Teachers' Reading & Use of a National Mathematics Curriculum

Teachers' reading & use of a national mathematics curriculum as professional works

According to Watson (2001), teacher professionalism in countries, where a national curriculum is implemented is closely related to curriculum management. This is because revisions to the national curriculum can significantly influence teachers' work. Research on teachers' expertise in reading and utilization of the national curriculum has been conducted over the past several decades.

Early discussions of teachers' curriculum expertise can be traced back to those on teachers' knowledge. Shulman (1986) identified curricular knowledge as a component of teacher knowledge, along with content knowledge and pedagogical content knowledge.

Curricular knowledge refers to what teachers need to know about curriculum materials and includes both lateral (knowledge of connections with other subjects) and vertical curricular knowledge (knowledge of previous or subsequent topics within the same subject). Building on Shulman's (1986) concept of teacher knowledge, Ball et al. (2008) introduced mathematical knowledge for teaching consisting of knowledge of content and curriculum (KCC) as a component of pedagogical content knowledge. KCC includes an understanding of how to utilize existing curricula to teach particular content. The concept of curricular knowledge has been expanded into the concepts of curricular reasoning (Breyfogle et al., 2010) and curricular noticing (Dietiker et al., 2018), both of which denote teachers' expertise in handling curriculum materials such as textbooks.

One criticism raised against the aforementioned concepts of curricular knowledge, reasoning, and noticing is that the scope of the curriculum is limited to materials such as textbooks, thereby imposing constraints when applied to countries implementing a national curriculum (e.g., Petrou & Goulding, 2011; Tran & O'Connor, 2023; Zhang & Stephens, 2016). This criticism has led to discussions on the nature of national curricula and the characteristics of teachers' expertise in reading and utilizing them.

First, a national curriculum imposes culturally recognized mandates on teachers, and recognizing these mandates is an aspect of teachers' professionalism (Deng, 2018; Tran & O'Connor, 2023; Zhang & Stephens, 2016). In this regard, Petrou and Goulding (2011) argued that teachers' expertise should encompass not only knowing the curriculum materials available to them but also perceiving the mandated aspects of the national curriculum with which they engage. Zhang and Stephens (2013, 2016) proposed the concept of teacher capacity, which included the interpretation of the intentions of the official mathematics curriculum as a component. Teacher capacity emphasizes that national curriculum revisions can be realized by teachers interpreting and carefully applying the mandated or recommended elements included in their official curricula (Zhang & Stephens, 2016). Tran and O'Connor (2023) argued that a national curriculum offers constraints and possibilities for teachers' professional spaces, and within this professional space, teachers intentionally lead lessons, thereby achieving agency.

Second, teachers' professional knowledge includes understanding the goals and content presented in their national curriculum (Deng, 2018; Tran & O'Connor, 2023; Zhang & Stephens, 2016). The concept of teacher capacity proposed by Zhang and Stephens (2016) includes knowledge of mathematics (the core mathematical ideas necessary for teaching specific content) as another component. Tran and O'Connor (2023) argued that teachers engaged in their national

curriculum use knowledge of mathematical content in the process. Deng (2018) reconceptualized pedagogical content knowledge in the context of implementing a national curriculum, incorporating knowledge of institutional goals and content for teaching.

These studies underscore the role and importance of teachers' understanding of goals and content in their national curriculum documents and perceptions of their mandates, supporting the idea that the scope of curriculum resources professionally handled by teachers extends beyond textbooks to national curriculum documents. This perspective also applies to Korea, which has a centralized educational system and operates a national-level curriculum. Korea's national curriculum guides teachers' classroom practices by presenting content for teaching and the goals to be pursued while also providing autonomy by not strictly defining them and allowing for interpretation. In light of this perspective, when analyzing teachers' sense-making of curriculum messages, this study focuses on their understanding of institutional goals and content, as well as their perceptions of the mandated aspects of the curriculum.

Prior research on teachers' reading & use of national mathematics curriculum

Empirical studies have been conducted on how teachers read and use national curricula. While interest in reading and using national curriculum documents is less pronounced than in textbooks (e.g., Breyfogle et al., 2010; Brown, 2009; Dietiker et al., 2018; Gueudet & Trouche, 2009; Land et al., 2015; Pepin et al., 2013; Remillard, 1999, 2000; Roth McDuffie et al., 2018; Sherin & Drake, 2009), significant findings have emerged.

First, some teachers prioritized national curriculum documents as primary curriculum resources. The national curriculum aids teachers in setting learning objectives related to content for teaching and in guiding them in planning and implementing their lessons. Misfeldt et al. (2019) found that a Danish teacher planned lessons and anticipated student responses based on a national curriculum. In this context, the national curriculum served as a resource for practicing object-oriented teaching, wherein the teacher determined what to do based on what students are expected to learn.

In a study by Kaur et al. (2006), a Singaporean teacher referred to the government-provided curriculum when designing lessons, confirming the scheme of work before consulting textbooks. Similarly, in Grave and Pepin's (2015) study, Norwegian teacher Lillian used a national curriculum to establish short- and long-term goals for her lessons. By leveraging the national curriculum, she was able to adjust her instructions according to the curriculum's goals rather than offloading responsibility to textbooks.

Second, other teachers predominantly used textbooks as their main curriculum resource, referencing national curriculum documents as secondary resources or hardly referring to them at all. Researchers discussed how these findings may constrain teaching practices. According to Paik (2015), who surveyed the curriculum decision-making of over 1,000 teachers in Korea, responses indicating the frequent utilization of national curriculum documents in decision-making ranged from 2.0%-30.0%, whereas those indicating the frequent usage of textbooks varied from 6.0%-80.0%. Paik (2015) cautioned that teachers who rely overly on textbooks may overlook students' needs or local characteristics. In Grave and Pepin's (2015) study, Norwegian teacher Cathrine offloaded responsibility to textbooks rather than feeling the need to refer to her national curriculum when setting goals and deciding on instructional methods. Her lesson plans lacked clear objectives, resulting in arbitrary classroom teaching. In an analysis of textbook critiques by Taiwanese teachers, Yang and Liu (2019) found that a relatively low proportion (9.2%) of critiques by teachers considered the instructional goals outlined in textbooks. Teachers rarely explicitly referenced the goals outlined in the national curriculum as criteria for their critiques. Finally, the literature reports cases in which teachers refer to instructional materials (e.g., the Internet resources) other than official curricula in lesson planning (e.g., Davis et al., 2013). It is difficult to assert that such materials necessarily encompass the core principles that penetrate school mathematics (Remillard & Heck, 2014).

These studies suggest that encouraging teachers to integrate national curriculum documents as a curriculum resource can complement the limitations observed when teachers refer solely to textbooks or other informal instructional materials. Specifically, national curricula can assist teachers in setting clear goals, as well as planning and implementing coherent instruction. However, this study aims to address two critical gaps in the literature. First, while researchers have broadly examined the utilization of national curricula, there is a lack of analysis focusing on how teachers read them. Consequently, how teachers interpret the goals, content, and mandates imposed by national curricula (Deng, 2018; Zhang & Stephens, 2016) remains underexplored. Second, despite the exploration of how teachers resolve professional tasks using national curriculum documents, there has been insufficient discussion of how document-reading contributes to teacher learning. An essential objective of this study was to clarify the relationship between reading and sense-making of a national curriculum in context of competency-oriented reform.

Conceptual framework

The analysis in this study was based on Remillard's (2005) framework, which conceptualizes curriculum use as a participatory relationship between teachers and the curriculum.

From this perspective, curriculum use occurs through a dynamic interplay between teachers' resources (e.g., knowledge and perceptions) and the curriculum within specific contexts (Remillard, 2000, 2005; Roth McDuffie et al., 2018). The interaction between teachers and the curriculum yields a planned and enacted curriculum (Remillard, 2005).

We applied Remillard's (2005) conceptualization by considering the following five aspects. First, Remillard's (2005) conceptualization constrains the scope of the curriculum to materials such as textbooks; however, this study expands it to include national curriculum documents. Second, this study focused on the interpretation of curriculum texts, particularly during teachers' curriculum use, as interpreters' sense-making can be discerned through the meanings that emerge in the curriculum interpretation process (Ben-Peretz, 1990; Hodge, 2023). Third, the analysis centered on the interaction between teachers and the curriculum, and the planned curriculum developed from this interaction. The planned curriculum was a focus because previous studies have reported that interactions between teachers and their national curriculum are notable in the lesson planning stage (e.g., Grave & Pepin, 2015; Kaur et al., 2006; Misfeldt et al., 2019). Fourth, competency-oriented mathematics curriculum revision was considered an important factor in the context of the interaction between teachers and the curriculum (Watson, 2001). Fifth, within the participatory relationship, the focus includes teacher resources, specifically knowledge (understanding of institutional goals and content) and perceptions of mandated aspects because such teacher resources are mobilized in the interpretation of a national curriculum (Deng, 2018; Petrou & Goulding, 2011; Zhang & Stephens, 2016).

We also focused on the structure of the Korean national curriculum (goals, content, and methods), with the content including concept and procedure topic elements and achievement standards, whereas the methods encompass teaching and assessment strategies. The conceptual framework of this study is illustrated in Figure 1.

METHODS

Participants & Setting

The participants of this study included teachers who attended a three-month graduate course instructed by the authors; the course covered the interpretation of the 2022 revised mathematics curriculum in Korea (MOE, 2022). 18 in-service primary and secondary school teachers who enrolled in the course participated in the study. While all the participants were familiar with reading textbooks or teacher guides, they lacked prior experience in deeply reflecting on national curriculum documents, a trait typical of most Korean teachers.

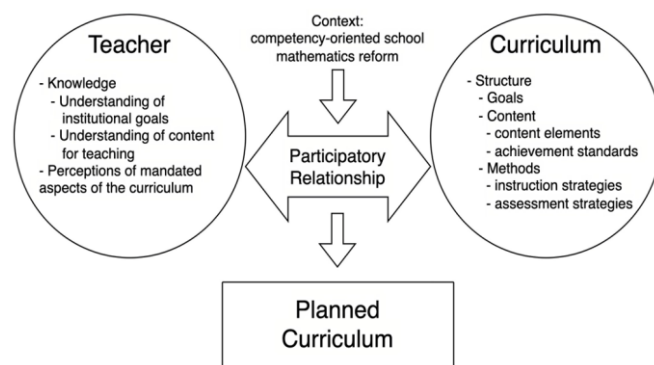


Figure 1. Participatory relationship between teacher & curriculum (Adapted from Remillard, 2005, p. 235)

The objectives of the graduate course attended by the teachers were to gain a profound understanding of the 2022 revised mathematics curriculum and to seek ways to enhance its implementation. The course spanned 15 weeks. In the first three weeks, the instructor explained the changes to the 2022 revised mathematics curriculum, including its shift towards competency development. By the third week, the teachers had formed groups of three to four members and selected content topics for focused interpretation of the national curriculum documents. From the fourth to fifteenth weeks, group presentations and discussions on curriculum interpretation were held both within each group and collectively across the entire classroom setting.

In addition, three writing assignments on interpretation of the 2022 revised mathematics curriculum were given (after the third, eighth, and fourteenth week). While this course did not require teachers to implement actual lessons based on these assignments, undertaking them paralleled the professional curriculum use in several respects. First, the writing assignments required the interpretation of the national curriculum documents and associated materials, thereby facilitating experiences in curriculum reading (Hodge, 2023; Remillard, 2005) and promoting the utilization and development of curriculum knowledge (Petrou & Goulding, 2011; Tran & O'Connor, 2023). Second, the assignments required ways to link the outcomes of interpreting the national curriculum with its implementation, thereby facilitating the experiential process of developing a planned curriculum (Remillard, 2005).

Support was provided for teachers' writing assignments. The initial assignment, written early in the course, presumably reflected the minimal influence of the lessons learned. However, the latter two assignments benefited from the authors' feedback (Figure 2), as they improved their earlier assignment based on the feedback. This feedback was predominantly informed by the literature, which will be elaborated below.

The instructor's feedback on the first assignment included four main points:

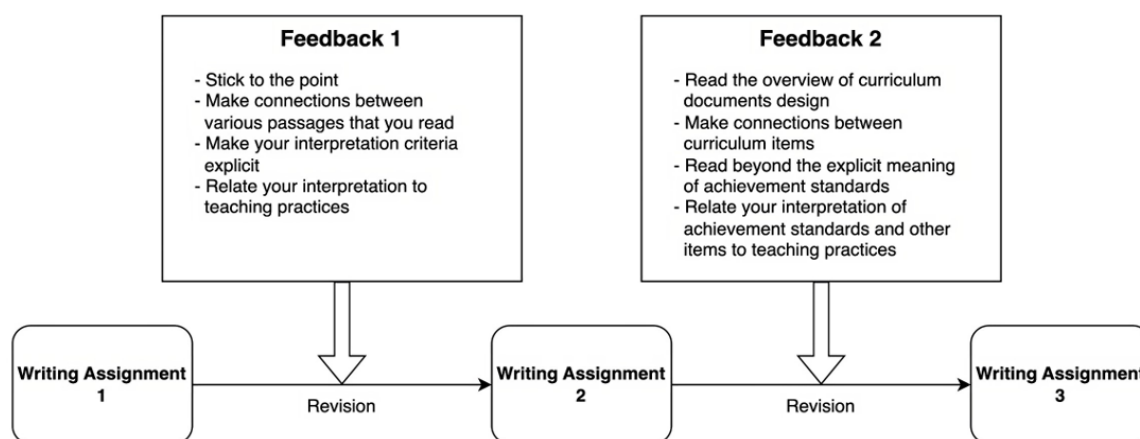


Figure 2. Feedback on writing assignments provided to teachers (Source: Authors' own elaboration)

First, the participants were encouraged to read the details of the curriculum (Sherin & Drake, 2009) because they often overlooked the contents of the documents and instead focused on issues that were difficult to directly relate to the contents of the documents, such as controversial social issues. The second suggestion was to make connections between various passages of the curriculum text (Hodge, 2023) and to read between the lines, as instances of teachers reading partially and selectively were noted. Third, teachers were advised to use explicit criteria for curriculum interpretation (Ben-Peretz, 1990). Fourth, teachers were guided to link their interpretations and teaching practices to foster a participatory relationship, leading to the development of a planned curriculum (Remillard, 2005).

The feedback on the second assignment was characterized by a more specific consideration of the structure of the "curriculum as a special kind of text" (Hodge, 2023, p. 10). It encompassed four main suggestions: First, teachers were encouraged to examine the general outline of the curriculum (Sherin & Drake, 2009) and make a link between the 'whole' and the 'part' of the curriculum texts (Hodge, 2023). Second, making the connections between document items and reflecting more on each item's role was recommended for relational reading while considering the structure of the curriculum (Hodge, 2023). Third, interpreting the underlying meanings of achievement standards was advised to clarify the relationship between subject matter and competency goals (Højgaard & Sølberg, 2023; Niss & Højgaard, 2019). Finally, elaborating on the relationship between teaching practices and the interpretation of achievement standards, or other aspects, was suggested to encourage a more developed participatory relationship (Remillard, 2005) and establishing interpretation criteria (Ben-Peretz, 1990).

Data Collection & Analysis

This study collected and analyzed teachers' writing assignments. Data from 17 of the 18 participants (T1-T17) were collected and analyzed due to the non-submission

of some assignments by one participant. The total lengths of the writing were 154, 285, and 465 pages for writing assignments 1, 2, and 3, respectively. Content analysis methods (Mayring, 2015; Roller & Lavrakas, 2015) were employed for data analysis in four stages.

The first and second stages were aimed at addressing **RQ1**. In the first stage, the data were systematically condensed and coded (Roller & Lavrakas, 2015). A total of 248 paragraphs containing the term "competency" were extracted from the third assignment, anticipating diverse interpretations from teachers, and codes related to curriculum reading characteristics were assigned, allowing for duplicates. In the second stage, overarching categories were identified from the codes, and themes were derived from these categories (Roller & Lavrakas, 2015). This yielded seven categories and three themes.

The third and fourth stages were geared towards addressing **RQ2**. In the third stage, based on prior research on teachers' policy sense-making (Bergqvist & Bergqvist, 2020; Boesen et al., 2014; Bümen & Holmqvist, 2022) and data from this study, the teachers' sense-making of competency-oriented curriculum messages was categorized into indifference, assimilation, and accommodation. *Indifference* refers to no mention of competency; *assimilation* indicates the sense-making of the messages without a change in existing understanding; and *accommodation* denotes the development of new understanding by relating the messages to existing knowledge (Boesen et al., 2014). The prevalence of sense-making among teachers at the time of writing was counted to identify the overall trends in teachers' sense-making as reading continued (Mayring, 2015). In the fourth stage, the relationship between reading and sense-making was explored. The analysis is based on a participatory relationship perspective (Remillard, 2005). Two patterns of relationships related to the types of sense-making were identified from the data: monologic and dialogic. **RQ2** was addressed by examining how the three reading themes manifested within these two relationship patterns and determining the types of sense-making associated with each pattern.

Table 1. Categorization of teachers' reading of national curriculum documents

Type	Code of subtype	Description
Identifying	IG	Identifying competency as a curriculum goal
	IC	Identifying the competency-oriented content structure
	IM	Identifying the competency-oriented teaching methods
Clarifying	CR	Clarifying meaning of the content and responsibilities for competency-oriented teaching
	CA	Clarifying the meaning of the content and authorities for competency-oriented teaching
Extending	EM	Extending to the critique of instructional materials
	ED	Extending to the design of teaching

RESULTS

What Types of Reading Do Teachers Use?

Teachers' curriculum reading was classified into three types, each including two to three subtypes, as shown in **Table 1**. Below are detailed descriptions of each type and subtype, accompanied by representative examples that support them.

Identifying

The essence of *identifying* lies in recognizing the competency orientation manifested in the national curriculum. This involves considering competency as a goal within the curriculum and recognizing the relationship between the content, methods, and competence goals of the national curriculum. The main characteristic of teachers' identifying was pursuing an understanding of the objective and manifested meanings within the curriculum text rather than relying on their subjective interpretations. The subcategories of identifying could be divided into three, corresponding to the structure of the national curriculum documents (goals, content, and methods).

Identifying competency as a curriculum goal (IG): Teachers who viewed competency as a curriculum goal considered the curriculum itself as a structure that stated goals, content, and methods. The teachers primarily recognized competency goals based on statements in the curriculum design overview. For instance, T7 highlighted that the documents explicitly stated that the "general objective [of the reformed curriculum] is to cultivate mathematical competency (MOE, 2022, p. 3)," and based on this, concluded that the revised curriculum intended a "paradigm shift to naturally developing competency." Other teachers compared previous and newly revised curriculum statements as criteria for interpretation. For example, T4 pointed out that "unlike in the 2015 [revised curriculum], in [the] 2022 [revised curriculum], the word 'competency' is used in the goal statements," interpreting this as an intentional emphasis on competency goals as objectives of the curriculum.

Identifying competency-oriented content structure (IC): IC involves recognizing that the multifaceted nature of the content structure in the revised curriculum is related to competency goals. Teachers read by IC often perceived curriculum-oriented messages from the

curriculum design overview statements. For example, T15 interpreted, as follows.

"When examining the curriculum design overview, it is suggested that these three elements [knowledge or understanding, processes or functions, and values or attitudes] are considered for development of mathematical competencies. In other words, the documents imply an intention to treat values and attitudes, which have traditionally been conceptualized as attitudinal domains corresponding to knowledge and skills, as content to be taught to foster mathematical competency."

Other teachers perceived the content structure as competency-oriented through comparisons between the previous and revised curricula. For example, T4 noted that the 'attitude and practice competency' in the previous curriculum was replaced by its integration into the three content categories (knowledge or understanding, process or skills, and values or attitudes) in the reformed curriculum. Thus, T4 interpreted the content structure as reflecting the multifaceted nature of competency.

Identifying competency-oriented teaching methods (IM): In the 2022 revised mathematics curriculum, teaching methods for fostering competency, such as student-centered learning and process-centered assessment, are proposed. Teachers identified these teaching methods as indicative of the curriculum's competency orientation. For example, T12 noticed a mention of process-centered assessment ("conducting assessments that emphasize the process through the integration of instruction and evaluations to aid students' mathematics learning (MOE, 2022, p. 47)"), and interpreted it as emphasizing "process-centered assessments that evaluate students' competencies in utilizing mathematics", thereby recognizing its competency orientation. For another instance, T1 interpreted the statement "considering the analysis of given conditions and information, and exploring appropriate problem-solving strategies (...) (MOE, 2022, p. 44)" as a competency-oriented method for teaching the achievement standard "[12PS-02-02]. Understanding data collection methods and selecting appropriate data collection methods for problem situations."

Clarifying

The 2022 revised mathematics curriculum refrains from strictly defining the meaning of competency to allow for professional and autonomous interpretations by teachers. Moreover, the curriculum does not specify which sub-competencies (problem-solving, reasoning, communication, connections, and information-processing) are associated with individual content elements and achievement standards. Consequently, teachers found it challenging to interpret the competency orientation of the curriculum solely by relying on the information explicitly stated in the documents. At times, they felt ambiguous in understanding the relationship between the competency goals and the subject matter to be taught. The interpretation aimed at refining this ambiguous meaning to pursue clarity is termed *clarifying*. Clarifying extends beyond reading explicitly stated information in the national curriculum. By clarifying, teachers generated alternative interpretations when explicit information alone was insufficient for understanding and subsequently selected plausible interpretations. Through this process, the implicit relationship between subject matter and competency goals within the curriculum became explicit and was perceived by the teachers. Thus, a key characteristic of clarifying was to restructure the curriculum through the interaction between the explicit or implicit meanings of the text and the teachers' subjective interpretations. Clarifying demanded that the teachers actively collaborate with the curriculum (Remillard, 2005). During this collaborative process, the teachers became aware of their mandates for implementing competency-oriented education. The subdivision depended on whether the teachers focused more on clarifying responsibilities or authorities related to the mandates.

Clarifying meaning of content & responsibilities for competency-oriented teaching (CR): Teachers who perceived competency development as a curriculum goal and acknowledged its value felt responsible for guiding achievement standards towards competency development. However, because the national curriculum documents did not explicitly specify the relationship between the subject matter embedded in each achievement standard and competency goals, the teachers experienced ambiguity regarding the specific competency goals to focus on when guiding achievement standards. This ambiguity led to interpretations aimed at specifying the relationship between the subject matter and competency goals.

These interpretations were made primarily in two ways. One was forming interpretations that established a correspondence between the subject matter embedded in an achievement standard and a competency goal. For example, T16 speculated that if achieving a standard contributes to competency development, each achievement standard would establish some

correspondence with the one sub-competency to which it contributes. T16 confirmed that he could establish one-to-one correspondence between subject matter and sub-competency for selected achievement standards in calculus domain enabling a clearer understanding of the tasks to consider for competency-oriented teaching:

[12C1-03-04] Understand the relationship between indefinite integration and definite integration and calculate the definite integration of polynomial functions.

→(Subject matter) Fundamental theorem of calculus
(Competency goal) connection competency

[12C1-03-05] Solve problems related to the area of shapes enclosed by curves.

→(Subject matter) Definite integration
(Competency goal) problem-solving competency

The second method of clarifying the meaning of achievement standards in the context of competency goals involves refining the relation between the subject matter embedded in an achievement standard and a competency goal. For instance, T13, when considering the achievement standard "[10CM1-04-02] Perform matrix operations and solve related problems," focused on the properties of matrix operations as the content for teaching and felt a responsibility to teach it in a manner that fosters competency development. During the document reading process, T13 noticed a description of assessment methods for reasoning competency in the document ("The assessment of reasoning competency considers ... [how a student] makes conjectures and generalizations based on observations, provides evidence for conjectures, justifies reasoning validly, ... (MOE, 2022, p. 73)"), enabling her to clarify the content for teaching. Specifically, T13 divided the process of reasoning into *conjecturing*, *generalizing*, and *justifying*. T13 also refined the content of 'properties of matrix operations' using those three categories, thus allowing T13 to articulate the competency goal targeted at teaching the achievement standard.

The fact that T16 and T13 perceived their responsibility for competency-oriented teaching does not imply that they were led to consider institutional goals and content in contrast to their existing orientations. As they valued competency-oriented mathematics education, clarifying responsibilities also meant clarifying the institutional goals and content according to their orientation. Other teachers who interpreted and clarified their responsibilities followed a similar rationale.

Clarifying meaning of content & authorities for competency-oriented teaching (CA): While interpretations clarifying responsibilities for

competency development constituted a convergent analysis that incrementally specified the relationship between the focused subject matter and a competency goal, interpretations clarifying authorities for competency development represented a divergent analysis that sought out various possibilities for guiding specific subject matter towards competency development. This allowed teachers to recognize their mandates for competency-oriented teaching while simultaneously elaborating spaces of autonomy within such mandates.

For instance, T2 sought to grasp the significance of teaching the achievement standards “[10CM1-02-04] Connect quadratic equations and functions and explain their relationship” and “[10CM1-02-11] Connect quadratic inequalities and functions, explain their relationship, and solve quadratic inequalities and simultaneous quadratic inequalities” as targets for competency development. T2 easily derived the interpretation that these achievement standards, containing the word “connect,” allowed for teaching the subject matter (quadratic equations, quadratic functions, and quadratic inequalities) with the goal of connection competency. T2 then considered alternative interpretations. This consideration led to interpretations aimed at investigating a range of possible sub-competencies that could be targeted in teaching the achievement standards. Drawing from considerations among the guidelines for applying the achievement standards presented in the national curriculum documents, T2 interpreted, as follows:

“(a) Technology can be utilized to investigate the position of a graph of a quadratic function relative to the x-axis and other lines, as well as the maximum and minimum values of a quadratic function.

(b) Technology can be used to investigate solutions to quadratic and simultaneous quadratic inequalities by using a graph of a quadratic function.

These statements [in the documents] recommend the use of technology to connect quadratic functions, equations, and inequalities. Furthermore, they encourage activities that use technology by visualizing the relationships between abstract mathematical concepts to facilitate intuitive understanding and communication. Thus, the achievement standards [10CM1-02-04] and [10CM1-02-11] can be interpreted not only as emphasizing connection competency but also as highlighting the information-processing competency of using technology, the reasoning competency of exploring mathematical concepts in various ways,

and the communication competency of describing relationships between mathematical concepts.”

Through these interpretations, T2 understood that, besides targeting connection competency, she could also aim to teach for developing reasoning, communication, and information-processing competencies. This interpretation contrasted with the interpretations by T13 and T16, who narrowed down the tasks by relating each achievement standard to only one sub-competency. T2 perceived that, rather than recognizing all the sub-competencies as goals to be achieved, she had the authority to focus on some or all of them as educational goals to realize competency education.

Extending

The 2022 revised mathematics curriculum documents do not contain detailed descriptions of specific teaching activities, such as tasks that can be used. Instead, the documents are mainly composed of brief and abstract descriptions of teaching goals, content, and methods. To integrate this into classroom practice, teachers interpreted competency-oriented curricula more practically by connecting them to other curriculum resources or lesson plans. This interpretation, referred to as *extending*, is seen as a reading approach that requires active involvement from teachers (Remillard, 2005). Extending encompasses two subcategories.

Extending to critique of instructional materials (EC): Teachers’ interpretation of general statements presented in the curriculum documents sometimes led to critiques of instructional materials. Specifically, interpretations of the national curriculum documents served as criteria for textbook critiques. This enabled teachers to understand the characteristics, strengths, and weaknesses of textbooks from a competency perspective. For example, T15 critiqued a textbook based on her interpretation of a competency-oriented curriculum associated with the textbook (the 2015 revised national mathematics curriculum). She critiqued the textbook in terms of its

- (1) goals,
- (2) content, and
- (3) methods according to the structure of the curriculum documents, with analyses of the goals and methods directly related to the interpretation of competency (see **Table 2** for details).

By analyzing how each element of sub-competency in the 2015 revised national mathematics curriculum (problem-solving, reasoning, communication, information-processing, creativity, and attitudes/practices) was embedded in the textbook tasks, T15 was able to discern the distribution of each sub-competency reflected in the tasks. Through an analysis of teaching methods, she determined the alignment between approaches in the textbook tasks and

Table 2. T15’s critique of textbook tasks in terms of competency

Guiding questions	T15’s textbook critique	Interpretation of national curriculum as criteria for critique
“How are nature & goals stated in national curriculum related to textbook tasks?”	“On examining tasks presented in introductions, examples, practice problems, & special corners of each subsection, it was generally found that they can be linked to problem-solving & information-processing competencies. Also, a few tasks related to communication competency are present. But tasks related to reasoning competency & attitudes & practices competency were difficult to identify.”	Competencies targeted in 2015 revised national mathematics curriculum include problem-solving, information-processing, communication, reasoning, creativity, as well as attitudes & practices.
“How is teaching, learning, & assessment direction stated in national curriculum related to textbook tasks?”	“Context of tasks used in textbook is closely related to students’ daily lives, such as cooking ramen, school cafeteria menus, using school stores, & using smartphones. Tasks also involve using national statistics portal to survey & analyze air pollution levels, peer relationship satisfaction, & other topics, reflecting intention of curriculum document to develop information-processing competency.”	A guide is presented in national curriculum: “To develop information-processing competency, explore & collect appropriate data in real-life & mathematical problem situations; organize, analyze, & evaluate them according to their purpose; & use analyzed information appropriately in problem situations.”

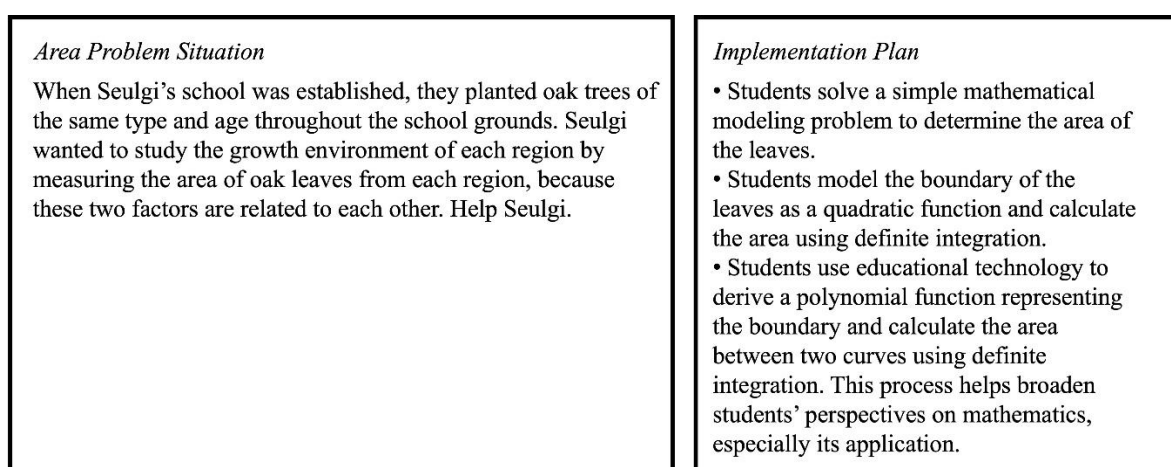


Figure 3. Task for problem-solving competency & its implementation plan designed by T16 (Source: Authors’ own elaboration)

the teaching methods for information-processing competency suggested in the national curriculum documents. Thus, by critiquing the textbook based on her identification of competency goals in the documents, T15 assessed the strengths and weaknesses of the learning opportunities in the textbook in terms of competency development. This suggests that T15’s critique prepared her to adapt textbooks as needed, considering the local context of future endeavors for competency teaching.

Extending to design of teaching (ED): ED involves translating the understanding derived from national curriculum documents into concrete forms that can be integrated into lesson planning. This interpretation is manifested in various ways, including the design of teaching principles, assessment methods, and educational tasks. As an example of a teacher’s task design, T16 devised a task and its implementation plan as illustrated in **Figure 3**.

This task was designed to teach the subject matter of definite integrals towards developing problem-solving competency, with the aim of achieving the standard

“[12C1-03-05] Solve problems related to the area of shapes enclosed by curves.” Notably, this task represented an extension of T16’s understanding of ‘problem’ and ‘problem-solving competency’ from the interpretation of the curriculum. T16 interpreted ‘problem’ not as a “typical problem that can be easily solved following predefined procedures” but rather as a problem that requires solving in “unfamiliar situations” using mathematical concepts effectively. Therefore, T16 deemed that fostering problem-solving competency was achievable by providing experiences in solving problems in the latter sense and designed a modeling task to calculate the leaf area to investigate the growth environment of trees.

What is Relationship Between Teachers’ Reading & Sense-Making?

Figure 4 illustrates the extent of teachers’ sense-making regarding competency orientation in the curriculum when each writing assignment was generated. The proportion of indifference decreased gradually from 64.7% to 29.4% and then to 5.9%, while

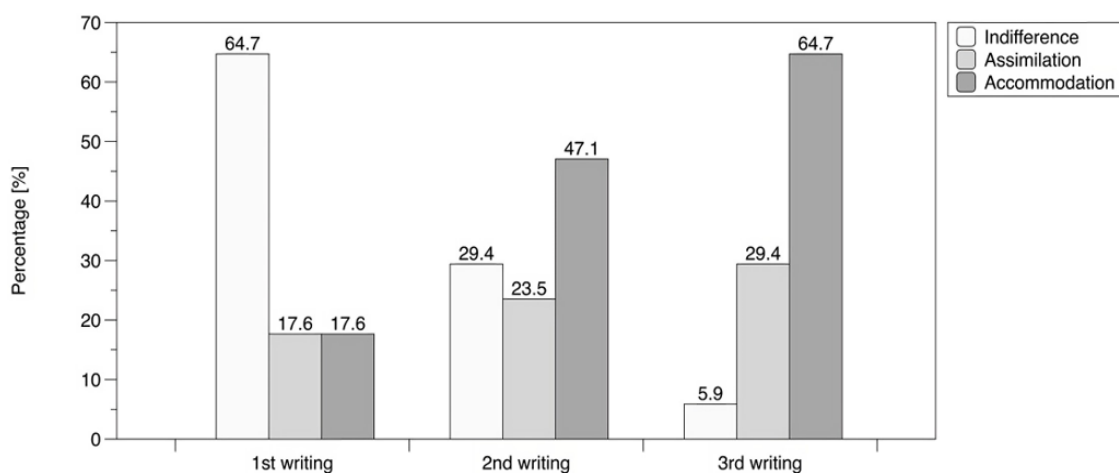


Figure 4. Trend in teachers' sense-making of competency orientation in curriculum across three writing assignments (Source: Authors' own elaboration)

those of assimilation and accommodation increased gradually from 17.6% to 23.5% and 29.4% and from 17.6% to 47.1% and 64.7%, respectively. These findings suggest that teachers' reading of the national curriculum documents generally led to a shift in their sense-making from indifference to assimilation and, subsequently, to accommodation. However, the relationship between reading and sense-making is complex. It was found that the manner of reading, rather than reading itself, was associated with sense-making. Accommodation emerged through dialogic reading, while assimilation was facilitated through monologic reading. Reading without identifying competency-oriented messages led to indifference towards competency orientation. Below, we elucidate the patterns of teachers' reading that lead to accommodation and assimilation accompanied by examples (Figure 4).

Reading that facilitates accommodation: Dialogic reading

A dialogic relationship, characterized by the dynamic interaction between teachers and the curriculum, facilitated not only changes in the resources of the teachers but also changes in the structure of the curriculum. Reading with this dialogic relationship, or dialogic reading, typically begins with identifying competency-oriented messages. At this stage, the teachers assimilated the messages into their existing perspectives to establish a starting point for a deeper understanding. During clarification, which followed identification, both the curriculum and the teachers underwent changes. Analytically, this process can be divided into two aspects: restructuring the curriculum and changing teachers' resources. First, one aspect of clarification involved restructuring the curriculum, indicating the objective aspect of interpretation. The teachers sometimes related parts of the curriculum text together, making implicit relationships explicit; at other times, they speculated about the underlying meanings important for a deeper understanding and searched for

other parts of the curriculum text that supported or refuted these speculations. Through such interpretations, the previously partitioned texts became interconnected, and the meaning of the curriculum text was refined, leading to curriculum restructuring. Another aspect of clarification involved teachers' accommodation, indicating the subjective aspect of interpretation. The restructured curriculum prompted the teachers to comprehend the new meanings of previously noted texts and elaborate on their understanding of what to teach, alongside their perception of mandates. This led to a change in the teachers' comprehension of competency orientation in the curriculum, which they initially acquired through identification. The fact that such new understanding often promotes extension reflects the connection between accommodation and teaching practices.

For example, T13 experienced dialogic reading, as shown in Figure 5. Initially, T13 established an initial understanding of competency goals and content for teaching based on explicit statements of curriculum goals ("develop mathematical competence by (...)") and an achievement standard ("[10CM1-04-02] Perform matrix operations and solve related problems") in the curriculum. At this stage, T13 assimilated the competency goals, but the content for teaching was understood as the 'properties of matrix operations,' which were somewhat static. T13's interpretation, aimed at a deeper understanding of the content in terms of competency, primarily led to the restructuring of the curriculum. That is, the relationship between the achievement standard and a description of the assessment methods for reasoning competency was newly revealed, centered on the goal of developing reasoning competency. Specifically, the description that the assessment of reasoning competency could involve conjecturing, generalizing, and justifying became related to the matrix operations presented in the achievement standard. The restructuring of the curriculum led T13 to understand the focused institutional goal of fostering

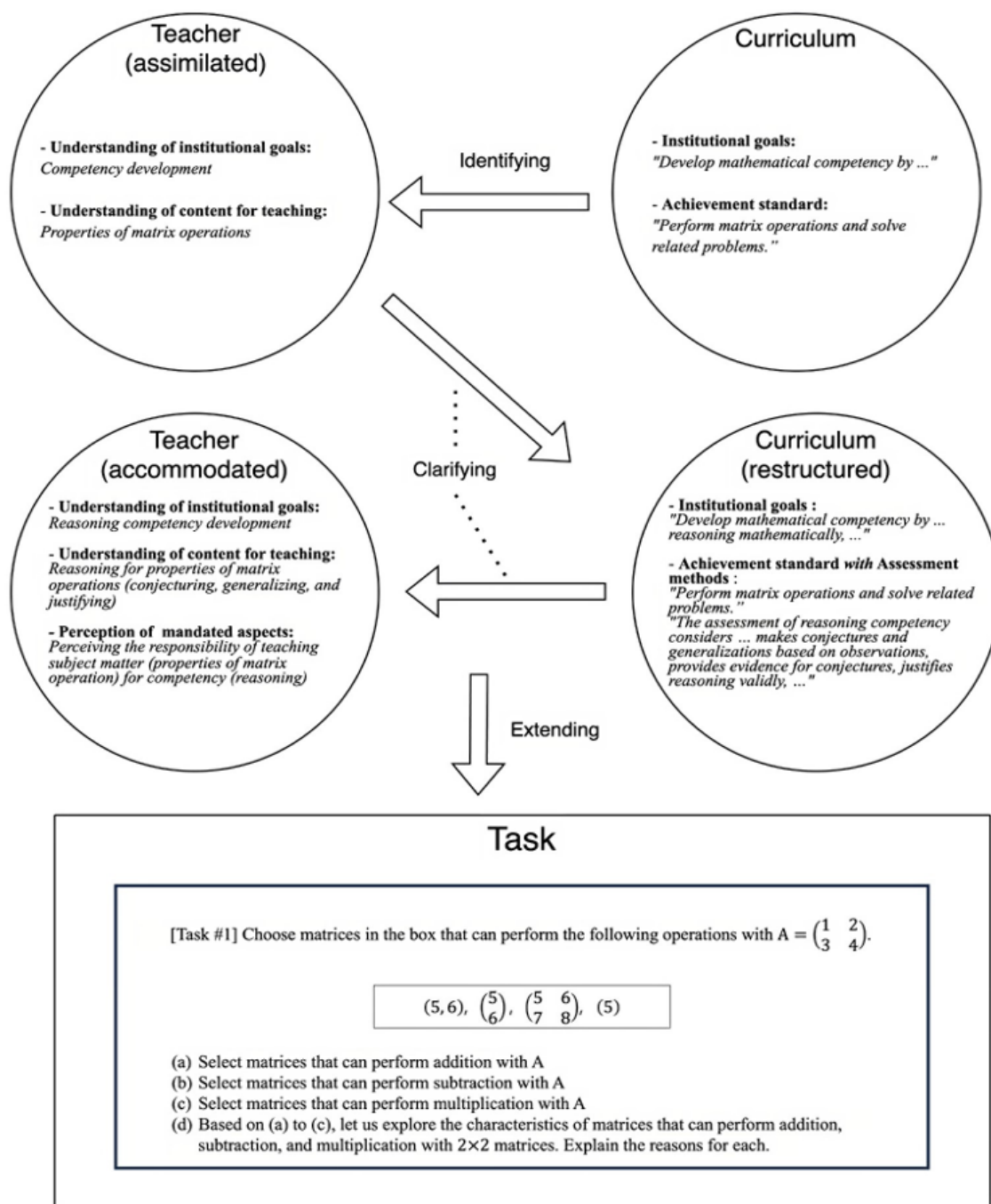


Figure 5. Dialogic relationship in curriculum reading of T13 (Source: Authors' own elaboration)

reasoning competency and to change her understanding of the content for teaching to include dynamic aspects such as conjecturing, generalizing, and justifying conditions for matrix operations. During this process, T13 clarified her responsibility for teaching content for competency development. These changes illustrate T13's accommodation of competency-oriented reform messages. The accommodation of T13 was also extended to task design.

According to T13, subtask (1) to subtask (3) of the task in Figure 5 aimed to provide a foundation for conjecturing regarding the property of computability of matrices through specific examples. The quest to "explore the characteristics" of matrix operation in the

subtask (4) aimed to demand conjecture and generalization based on the presented examples, while "explain reasons" part aimed to demand justification. The understanding of content as a dynamic process was reflected in task, demonstrating how accommodation regarding the competency orientation of the curriculum is applied in the context of teaching practices.

Reading that facilitates assimilation: Monologic reading

A monologic relationship, marked by separation between teachers and the curriculum, primarily manifested during identifying competency-oriented

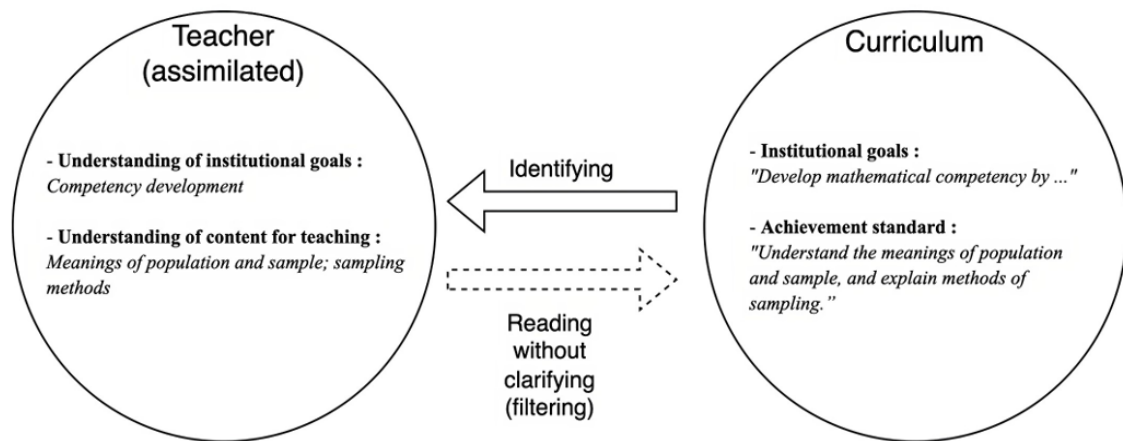


Figure 6. Monologic relationship in curriculum reading of T14 (Source: Authors' own elaboration)

messages without subsequent clarification, resulted in readings dominated by a single viewpoint. This led to cases in which the resources of the teachers or the curriculum text took precedence without collaborative participation between the two (Remillard, 2005).

In text-dominated reading, teachers granted significant authority to the curriculum text and interpreted the meaning of competency orientation from a singular perspective based on the text. In this approach, the meaning of the curriculum text was largely accepted as objective. Text-dominated reading mainly focused on identifying the intended messages of curriculum developers, with little consideration given to diverse perspectives or alternative interpretations of the curriculum text. Moreover, the teachers sought clear interpretations and concentrated on accepting facts that were explicitly presented. Consequently, their reports of what they read were descriptive. The teachers mainly quoted or indirectly cited the curriculum narrative; reading involving uncertainty, such as speculation and inference about the underlying meaning, was rare. Thus, by identifying alone, while objective and explicit policy messages regarding competency orientation in the curriculum text were activated, teachers' subjective frameworks did not appear to be significantly activated. Consequently, in this monologic reading, assimilation occurred, whereby interpretations did not cause changes in pre-existing frames.

In teacher-dominated reading, teachers identified surface-level aspects of competency orientation at some point but failed to clarify them. Instead, statements that could be related to competency were filtered through their pre-existing frames, resulting in interpretations that sometimes diverged from the curriculum developers' intentions. For example, Figure 6 illustrates the teacher-dominated reading process of T14. After recognizing the goal of competency development, T14 interpreted the achievement standard "[12PS-03-05] Understand the meanings of population and sample and explain methods of sampling." Regarding this standard, which was a modification of the achievement standard

"understand sampling methods principles" in the previous curriculum, T14 interpreted, as follows:

"There is no clear evidence of 'understanding,' and teachers cannot directly verify whether students have understood. Therefore, changing it to "explain methods of sampling" enables us to clearly verify whether students can execute sampling methods on their own."

While some teachers aimed to grasp the meaning of achievement standards by associating the verb "explain" with reasoning or communication competencies, T14 interpreted the verb "explain" as an observable assessment method of executing procedures (sampling methods). T14 understood the content for teaching as static procedures or skills. Although T14 identified competency-oriented goals in the national curriculum document, such reading did not alter her understanding of the content for teaching. While it cannot be said that T14's interpretation was incorrect, it did not lead to the restructuring of the curriculum; consequently, her new understanding of teaching content was not developed, resulting in assimilation towards competency-oriented curriculum messages.

DISCUSSION & CONCLUSIONS

In this study, we explored how 17 teachers who attended a graduate course read competency-oriented national mathematics curriculum documents in Korea and how their reading is related to their sense-making of competency-oriented messages in the documents. The analysis revealed three types of reading: identifying, clarifying, and extending. *Identifying* involved recognizing explicitly described competency-oriented aspects in the national curriculum documents, such as competency goals, and competency-oriented content structures and teaching methods. *Clarifying* the implicit meanings of competency-oriented statements in the national curriculum documents led to the clarification of the relationship between subject matter and competency

goals as well as teachers' perceptions of responsibilities or authority. *Extending* included interpretations that connect abstract descriptions of the national curriculum documents to specific practices (critiquing instructional materials and designing teaching). The teachers' reading approaches were related to their sense-making of competency orientation in the curriculum. Reading accompanied by clarifying formed a *dialogic* relationship between the teachers and the curriculum, leading to the *accommodation* of competency-oriented reform messages. Conversely, reading with identifying, but without clarifying, of reform messages led to a *monologic* relationship between the teachers and the curriculum, resulting in the *assimilation* of messages. Reading without identification resulted in indifference to competency orientation. We discuss the characteristics and significance of each reading type and consider points to support teachers' interpretations, including the role of feedback provided to teachers.

Identifying competency-oriented curriculum messages seems to play a pivotal role in addressing teachers' indifference towards the competency orientation of the curriculum, leading to either assimilation or accommodation. Consistent with previous research (Remillard, 2000; Roth McDuffie et al., 2018), teachers' initial orientation towards the curriculum appeared to prioritize content topics over competency orientation of the national curriculum. Consequently, the initial perspectives of over half of the teachers (64.7%) towards competency-oriented reform messages tended towards indifference. However, through identification, most were able to transition their sense-making from indifference to at least the level of assimilation. In addition to feedback encouraging the reading of detailed aspects, feedback to peruse the curriculum design overview was also found to be beneficial (Sherin & Drake, 2009) because it encourages linking between the whole and parts of the curriculum text (Hodge, 2023), by enabling teachers to re-attend and identify detailed competency-related information that they had missed before. By laying the groundwork for more sophisticated reading, teachers who identified competency-oriented messages were better prepared to accommodate them in subsequent readings. Thus, this study underscores the importance of 'identifying' as a reading approach that forms the cornerstone of nuanced reading, rather than relegating it to a lower-level reading approach.

Nevertheless, relying solely on identification requires caution, as it may lead to monologic reading dominated by either teachers or curriculum texts, resulting in assimilation rather than a deeper level of understanding. In this study, teacher-dominated reading involved interpreting the curriculum text primarily through pre-existing frames, even after identifying competency-oriented messages from certain parts of the text, without relating them to subsequent interpretations. This process

resembles the filtering process observed by Boesen et al. (2014). Text-dominated reading, a distinct reading approach not noted by Boesen et al. (2014), aimed to exclude subjective interpretations and focuses solely on extracting explicit textual meanings, thereby forming a monological relationship. To support teachers' understanding of the competency orientation of a national curriculum beyond assimilation, it may be advantageous to provide adaptive support by accurately understanding the relationship between teachers and the curriculum during the reading process. If the relationship is teacher-dominated, supporting interpretations that consider the objective aspects of the curriculum by relating parts of the text to each other and utilizing interpretations of previously identified messages could be beneficial. Conversely, if the relationship leans towards text domination, encouraging the formation of subjective interpretations by speculating on hidden meanings, albeit accompanied by uncertainty, may be effective.

Clarifying competency-oriented curriculum messages may play a significant role in guiding the accommodation of competency-oriented messages by fostering a dialogic relationship between teachers and the curriculum. Some of the literature suggests that teachers would benefit from in-depth examinations and clarifications of the relationship between subject matter and competency goals to enhance competency-oriented mathematics education (Højgaard & Sølberg, 2023; Niss & Højgaard, 2019). This study found that the feedback informed by this literature, which encourages interpretation of the implicit meanings behind achievement standards, appears to have assisted teachers in clarifying the relationship between subject matter and competency goals. Furthermore, this study contributes to the literature by elucidating how such a relationship is formed during the curriculum interpretation process. In this study, teachers and the curriculum mutually influenced and transformed each other through dialogic relationships. Through clarification, the teachers altered their sense-making of the relationship between subject matter and competency goals into accommodation (subjective aspect of change), which was accompanied by the restructuring of the curriculum, where parts were newly related, and a more refined meaning of the parts was generated (objective aspect of change). Teachers who encounter challenges in accommodating competency-oriented messages (e.g., Bergqvist & Bergqvist, 2020; Boesen et al., 2014; Bümen & Holmqvist, 2022) may get opportunities to develop their expertise for competency-oriented teaching through dialogic reading, as it requires teachers to articulate their understanding of goals and teaching contents for competency-oriented education.

Moreover, our findings highlight that clarification is not only a process of understanding content for teaching and institutional goals but also of perceiving the

mandated aspects of a national curriculum. Researchers have previously discussed perceptions of the mandated aspects of a national curriculum as part of teachers' expertise in handling it (Petrou & Goulding, 2011; Tran & O'Connor, 2023; Zhang & Stephens, 2013, 2016). This study contributes to literature, as we were able to refine the meaning of 'interpretation of the intentions of official mathematics curriculum' as a component of teacher capacity, as proposed by Zhang and Stephens (2016), confirming that teachers' interpretations of the mandated aspects of a competency-oriented national curriculum may include the complementary processes of clarifying responsibility and authority. In this study, teachers pursuing the *clarification of responsibility* engaged in convergent interpretations by specifying the relationship between subject matter and a competency goal. Such interpretations appear to assist teachers in articulating instructional goals and content for teaching, thereby partially explaining why teachers often use their national curriculum for object-oriented instruction (e.g., Grave & Pepin, 2015; Kaur et al., 2006; Misfeldt et al., 2019). Additionally, given that research indicates a high sense of responsibility among teachers in East Asian countries, particularly in Korea, to understand the content specified in their national curriculum (Cai & Wang, 2010; Lee, 2010), the clarification of responsibility might be influenced by the cultural contexts. On the other hand, teachers pursuing *clarification of authority* engaged in divergent interpretations by exploring various competency goals related to the subject matter they considered. Clarification of authority seems to be effective for teachers to prepare for adjusting their competency-oriented curriculum, responding to various educational contexts (Bümen & Holmqvist, 2022), and may also contribute to teachers' perceptions of their professional spaces (Tran & O'Connor, 2023). Because responsibility and authority clarification have different yet complementary advantages, teachers may benefit from developing expertise in handling a competency-oriented national curriculum through both processes.

The analysis of subcategories within 'extending' contributes to advancing prior research on the utilization of an official curriculum. Specifically, this study identified the design of teaching and the critique of instructional materials as subcategories of extension. Similar to the teachers in previous studies (Grave & Pepin, 2015; Kaur et al., 2006; Misfeldt et al., 2019), the teachers in this study extended their understanding of the national curriculum to lesson design. These outcomes appear to have been influenced by feedback that encouraged a participatory relationship between teachers and the curriculum for planned curriculum development (Remillard, 2005). We also noted that the findings regarding critiques of instructional materials can broaden the understanding derived from Yang and Liu (2019). According to Yang and Liu (2019), teachers can benefit from critiquing textbooks by understanding

their features, strengths, and weaknesses before adapting them for their students. Our study demonstrates that teachers could benefit even more from extending their understanding of their national curriculum as a criterion for critiquing textbooks. Specifically, teachers in this study, through extending curriculum interpretations, gained insights into which competency goals were adequately, partially, or rarely addressed in the textbooks' tasks, providing a basis for decision-making on how to adapt tasks in lesson plans to support student learning. Feedback recommending the clarification of interpretation criteria (Ben-Peretz, 1990) seems to have facilitated these interpretations. In countries, where textbooks are officially approved by the government, teachers may easily assume that the textbooks they use sufficiently reflect the orientation of the national curriculum, often leading them to disregard the national curriculum in favor of textbooks (Paik, 2015). However, the results of this study emphasize that if teachers integrate their competency-oriented national curriculum documents with their textbooks into the curriculum resource system and critique textbooks based on interpretations of the national curriculum documents, this could lead to the comprehension of strengths and weaknesses of their textbooks from the perspective of competency goals. The understanding of textbooks gained by this kind of critique may guide adjustment of curriculum materials in implementing competency-oriented mathematics education (Bümen & Holmqvist, 2022).

Although implementing a competency-oriented national curriculum is a global trend, there has been little interest in the literature on how interpreting competency-oriented national mathematics curriculum documents can assist teachers in competency-oriented education. This study addressed this gap by confirming the potential contribution of nuanced interpretations of a competency-oriented national curriculum to teachers' professionalism in handling the curriculum. Consequently, the findings in this study complement those from prior studies that have viewed competency-oriented national curricula as having objective structure and identified its potential benefits (e.g., Bergqvist & Bergqvist, 2017). The findings and implications of this study could be beneficial for supporting teachers in various countries with competency-oriented mathematics education. However, as this study focused on exploring teachers' reading and sense-making in the context of teacher education program, further research is needed to investigate their reading and understanding in school settings.

Author contributions: C-GS: formal analysis, software, visualization, writing—original draft preparation; C-GS & KHL: conceptualization, data curation, investigation, methodology, project administration, resources, supervision, validation, writing—review and editing. Both authors have sufficiently contributed to the study and agreed with the results and conclusions.

Funding: No funding source is reported for this study.

Ethical statement: The authors stated that the study was approved by Seoul National University Institutional Review Board on 17 March 2023 (Approval Number: 2303/003-007). Written informed consents were obtained from the participants.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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