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Klijnstra, T.; Stoel, G.L.; Savenije, G.M.; van Boxtel, C.A.M.

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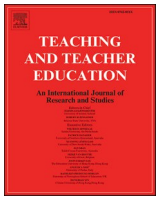
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Research paper



Teachers' professional growth in teaching students' social scientific reasoning

Thomas Klijnstra [a,*], Gerhard L. Stoel [b], Geerte M. Savenije [a], Carla A.M. van Boxtel [a]

[a] University of Amsterdam, the Netherlands
[b] Radboud University Nijmegen, the Netherlands

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ABSTRACT

This exploratory study investigates how the use of subject-specific educative curriculum materials in a professional development program contributes to the professional growth of Dutch social science teachers in teaching social scientific reasoning. Teachers' professional growth (N = 10) was examined using pre- and post-interviews and questionnaires. The analysis focused on changes in teachers' knowledge, beliefs, and instructional practice. The results indicate that teachers developed a deeper understanding of the complexity, difficulty, and subject-specific nature of social scientific reasoning. The subject-specific educative curriculum materials served as a catalyst for teachers' professional growth in teaching social scientific reasoning.

1. Introduction

Reasoning is a complex skill that poses challenges for both adults and young people. Many people struggle with reasoning, often making evident mistakes, reasoning inconsistently, and displaying biased decision-making (Evans, 2002; Fernbach et al., 2013; Klijnstra et al., 2023). Scientific reasoning is a broad category that spans various school subjects. However, it requires concretization and specification within each discipline (Lee et al., 2021). In a previous study, we operationalized reasoning in social science education, defining social scientific reasoning (SSR) as the application of sociological and political science concepts and methods to support students' reasoning about current social problems (Klijnstra et al., 2023). For instance, within social science education, students might investigate the growing concerns in society about rising crime rates among young people. To do so, they must first accurately describe the social problem (e.g., Is there a genuine increase in youth crime?). Next, they need to explain the issue, incorporating social scientific concepts such as social cohesion and social inequality. Finally, students should explore and evaluate potential solutions, including policy interventions, which could mitigate crime in society.

This type of reasoning poses significant challenges for students (Klijnstra et al., 2023), largely due to the inherent complexity of social problems, which involve multiple causes, consequences, and solutions, as well as correlations with other social problems and the influence of personal preconceptions and biases (Mills, 2000; Van Tubergen, 2020). Furthermore, SSR requires students to apply social scientific theories, models, and concepts to gain a deeper understanding of specific social problems (Klijnstra et al., 2023; Sandahl, 2015). To effectively teach this complex skill, teachers need a thorough grasp of SSR and knowledge of effective strategies and materials. However, previous research has shown that social science teachers often struggle to design and assess teaching materials that facilitate the analysis of social problems (Sandahl, 2015; Van Boxtel et al., 2017).

In this study, we explore educative curriculum materials (ECMs) as a potential solution to the challenges social science teachers face. ECMs are designed to support complex learning for both teachers and students. Research has shown that these materials enhance teachers' professional development by enriching their pedagogical content knowledge and classroom practices (Davis & Krajcik, 2005). However, their impact on teaching complex reasoning skills, such as SSR, remains unexplored. This study aims to investigate how social science teachers develop in terms of their perceived knowledge, beliefs, and skills in teaching SSR. Our research question is: How do subject-specific ECMs in a professional development program contribute to teachers' professional growth in teaching SSR in social science lessons?

* Corresponding author. Research Institute of Child Development and Education (RICDE), PO Box 15776, 1001 NG, Amsterdam, the Netherlands.
E-mail addresses: t.klijnstra@uva.nl (T. Klijnstra), gerhard.stoel@ru.nl (G.L. Stoel), g.m.savenije@uva.nl (G.M. Savenije), c.a.m.vanboxtel@uva.nl (C.A.M. van Boxtel).

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2. Theoretical framework

2.1. Pedagogical content knowledge and educative curriculum materials

To teach effectively, teachers must develop pedagogical content knowledge, which involves integrating pedagogical knowledge and subject-specific content knowledge to facilitate student learning (Shulman, 1986; Tammen et al., 2018). ECMs are designed to promote complex learning for both teachers and students (Ball & Cohen, 1996; Davis & Krajcik, 2005) and typically feature elements that support the development of teachers' pedagogical content knowledge (Bopardikar et al., 2021). ECMs, such as lesson materials and rubrics, can foster teachers' knowledge and competencies when accompanied by underlying design principles and clear descriptions of intended knowledge and skills. In our previous studies (Klijnstra et al., 2023, 2024), we designed and evaluated lesson materials to support students' SSR, including 1) rubrics defining components and levels of SSR; 2) a list of flaws that occur in students' SSR; and 3) design principles for teaching SSR with supportive sample lessons and instructional videos. This study investigates whether these materials also function as ECMs, supporting the development of teachers' pedagogical content knowledge. For example, the list of reasoning flaws can inform teachers' understanding of student learning. In the following sections, we will describe how these three subject-specific ECMs relate to components of teachers' pedagogical content knowledge.

2.1.1. Educative curriculum material 1: rubrics defining components and levels of SSR

Teachers' pedagogical content knowledge integrates pedagogical knowledge with subject-specific content knowledge (Krajcik & Delen, 2017; Magnusson et al., 1999; Shulman, 1986). For social science teachers, it is essential to understand the nature of SSR, the challenges students face, and how to translate these insights into teaching materials. Building on conceptualizations of domain-specific reasoning (Goldman et al., 2016; Lee et al., 2021), conceptualizations in social sciences (Sandahl, 2015; Ultee et al., 2003; Van Tubergen, 2020), and an analysis of students' reasoning on social problems, we previously conceptualized SSR (Klijnstra et al., 2023). This study defined SSR as comprising three components: describing a social problem, explaining a social problem, and analyzing possible solutions related to the social problem. For each component, we identified five reasoning activities: 1) causal analysis, 2) use of social scientific concepts, models, and theories, 3) use of evidence, 4) use of perspectives and reflecting on them, and 5) comparing. We categorized each activity into three proficiency levels. Table 1 illustrates an example from the rubric. The conceptualization and rubrics for SSR components and levels relate to the content of social science education (the "what" of teaching), and more specifically, the knowledge of the social science curriculum, a key component of teacher's pedagogical content knowledge.

At first glance, these reasoning activities seem generic and applicable to any discipline. However, the proficiency levels indicate their subject-specific nature. For instance, in SSR, causal analysis involves connecting causes and consequences to potential solutions, requiring students to examine social phenomena and collective behavior, rather than individual behavior (Sandahl, 2015; Van Tubergen, 2020). Students must also apply social scientific theories and models to their analysis, acknowledging that direct causality is rare in social sciences (Lundholm & Davies, 2013). The subject-specific nature of the rubric becomes more apparent at the advanced proficiency level (see Table 1). The rubric aims to support social science teachers in teaching SSR and assessing the quality of learning tasks and student reasoning.

Table 1
Example from Rubric 2: Explaining social problems.

Reasoning activities and subcategories	Beginning	Intermediate	Advanced
Causal analysis: Identifying causes	Identifies no or only one cause of the problem	Identifies multiple causes of the problem	Identifies multiple causes of the problem and distinguishes between different types of causes, including: - Socio-economic, socio-cultural, and political-legal angles. - Different scale levels (micro, meso, macro). - Normative and policy perspectives. - Incidental and structural causes

2.1.2. Educative curriculum material 2: list of flaws that occur in students' SSR

In line with components of pedagogical content knowledge (Magnusson et al., 1999), social science teachers also need knowledge of students' understanding of SSR. Previous studies have highlighted the challenges students encounter when reasoning about complex social problems (Klijnstra et al., 2023; Sandahl, 2015). These problems are characterized by multiple causes, consequences, and solutions (Mills, 2000; Van Tubergen, 2020), as well as conflicting values, norms, interests, and political views (Klijnstra et al., 2023; Mills, 2000; Ultee et al., 2003; Van Tubergen, 2020). Our previous study identified 18 reasoning flaws in students' SSR, based on papers written in social science lessons (Klijnstra et al., 2023). Some flaws are consistent with research on adult reasoning (Dawson & Venville, 2009; Fiske & Taylor, 2017) and reasoning in other subjects, such as historical reasoning (Stoel et al., 2015), and understanding of scientific knowledge (Perkins & Grotzer, 2005). An example of a reasoning flaw evident in multiple subjects includes students formulating causal relationships as laws rather than probabilities. Other reasoning flaws are more specifically related to SSR, such as students failing to recognize their own involvement or frame of reference when describing and explaining social problems or analyzing solutions (Klijnstra et al., 2023).

2.1.3. Educative curriculum material 3: design principles for teaching SSR with sample lessons and instructional videos

To promote students' SSR in social science lessons, teachers need to develop effective lessons. Design principles can serve as guidelines for creating teaching materials. In a previous study, we developed design principles to promote students' SSR (see Table 2). For example, Design Principle 1 emphasized the importance of acknowledging students' initial associations, prior knowledge, and intuitive responses to foster their reasoning. When students enter a social science classroom, their personal experiences, political intuitions and emotions related to the discussed problems can influence their analytical thinking and SSR (Klijnstra et al., 2023; Sandahl, 2020). Therefore, it is essential to address these prior beliefs to promote effective learning.

We developed our initial design principles based on our conceptualization of SSR and the theoretical frameworks for complex learning (Van Merriënboer & Kirschner, 2018), explicit instruction (e.g., Hughes et al., 2017; Merrill, 2002), and domain-specific principles for analyzing social problems (Van Boxtel et al., 2017). We then designed and evaluated concrete lesson materials based on these principles, and refined and expanded these principles in a more domain-specific manner (Klijnstra et al., 2023). The subject-specific relevance also applies to the other design principles. For example, Design Principle 3 focuses on explicit instruction, a general teaching strategy. However, in the context of SSR, explicit instruction addresses specific components and levels of SSR, as well as common flaws in reasoning about social problems. For instance, a teacher can model how to address multicausality and potential unintended consequences of proposed solutions and explain that causes and consequences should be framed in terms of probabilities

Table 2
Design principles for promoting students' social scientific reasoning with examples derived from sample lessons (see Klijnstra, Stoel, Ruijs, Savenije, & van Boxtel, 2024).

Design principle	Embedding in sample curriculum material[a]
1. When introducing a context or social scientific concept, make the development of SSR transparent by paying attention to students' initial associations, prior knowledge, and intuitive responses.	In the sample curriculum material *Decoding the News*, students analyze social problems through a sociological lens. They start by considering each context from a layperson's perspective, reflecting on their thoughts about a headline like "40% of cops engage in ethnic profiling".
2. Use specific social and political themes, processes, or problems in learning tasks as contexts to elicit wonder, explain SSR, and practice SSR.	The sample curriculum material *Reasoning with Social Science Concepts* compares the effects of the COVID-19 pandemic in different countries and population groups, making the abstract concept of social inequality more meaningful for students by creating new associations and examples.
3. Provide explicit instruction on the SSR activities emphasized in a learning task.	The sample curriculum material *Comparing Countries* includes an instructional video on SSR skills, providing explicit instruction on how to formulate a hypothesis using a familiar example for students: class excursions to enhance social cohesion.
4. Emphasize practicing one or several components of SSR within a learning task.	The sample material *Visualize Cause-and-Consequence Reasoning* focuses on sub-skills of causal analysis, such as distinguishing correlation from causation and identifying the direction of causal relation.
5. Support students with scaffolds, such as visual representation, to promote SSR.	The sample material *Visualize Cause-and-Consequence Reasoning* emphasizes using and creating diagrams. By working with partially completed examples, students learn to construct their own diagrams to map out possible causal relationships found in sources like newspaper articles.
6. Provide feedback on students' SSR based on clear indicators, such as the rubrics for SSR.	In the curriculum sample material *Decoding the News,* students compared their own strategies for decoding social problems with the teachers' strategies, which were derived from rubrics that define components and levels of SSR, such as learning to compare groups.

[a] This table shows one example per design principle, derived from the sample curriculum materials. More examples can be found in our previous study (see Klijnstra et al., 2024).

rather than laws (Van Tubergen, 2020).

By combining these design principles with concrete teaching materials (e.g., sample lessons or instructional videos) teachers can further develop their understanding of SSR and how to promote it in their students.

2.2. Interconnected model of professional growth

Previous studies on teachers' professional development have focused on changes in teachers' knowledge, beliefs, and practices to enhance student learning (Darling-Hammond, Hyler, & Gardner, 2017; Desimone, 2009; Guskey, 2000; Wei et al., 2009). Research indicates that professional development does not follow a linear path. The interconnected model of professional growth (Clarke & Hollingsworth, 2002) provides a framework to conceptualize this non-linear nature. Building on Guskey's (1986, 2000) model, it identifies four interconnected domains: 1) the personal domain (knowledge, beliefs, and attitudes); 2) the external domain (external information or stimuli); 3) the domain of practice (professional experimentation); and 4) the domain of consequence (salient learning outcomes). Changes in teachers' practices often interact with other domains, such as their personal domain, through mediating processes of enactment and reflection (Clarke & Hollingsworth, 2002; Wongsopawiro et al., 2017). From this perspective, teacher learning is a process that can begin in any domain (Justi & Van Driel, 2006; Schipper et al., 2017). ECMs, such as rubrics defining SSR proficiency levels, a list of reasoning flaws, design principles for teaching SSR, and sample lessons applying those principles can serve as stimuli or support in the external domain (Clarke & Hollingsworth, 2002).

The ECMs provided in the external domain can stimulate changes in other domains. First, teachers can directly integrate these materials into their practice. Second, the ECMs inform teachers about the domain-specific nature of SSR, different proficiency levels, and potential pitfalls in students' reasoning. Therefore, these materials have the potential to enhance teachers' knowledge and beliefs about SSR (personal domain). By using these materials in their social science classes, teachers can observe the impacts on students' SSR (the domain of consequence).

Although previous research offers guidance on designing professional development programs for teachers (Borko, 2004; Davis & Krajcik, 2005; Penuel et al., 2007; Van Veen et al., 2010), there is a lack of insight into teachers' professional growth in teaching reasoning skills within social science lessons. This study contributes to understanding the potential of using subject-specific ECMs to professionalize teachers in teaching domain-specific reasoning. The study aims to investigate how teachers develop their pedagogical content knowledge and educational practices related to SSR by using subject-specific ECMs within a professional learning community. In alignment with the components of pedagogical content knowledge and the interconnected model of professional growth, we focus on changes in teachers' beliefs, knowledge, and practices regarding (a) SSR as a curriculum-based skill; (b) students' understanding of and difficulties with SSR, and; (c) instructional strategies and learning activities for teaching SSR (see Clarke & Hollingsworth, 2002; Fraser, 2015; Grossman, 1990; Magnusson et al., 1999; Shulman, 1986). The ECMs used in this study were developed and validated in two previous studies (Klijnstra et al., 2023; Klijnstra, Stoel, Ruijs, Savenije, & van Boxtel, 2024).

3. Method

3.1. Context and participants

This study focuses on Dutch social science education, an optional exam subject offered in the Netherlands in the upper grades, starting in grade 10, across two educational tracks: higher general continued education and pre-university education. Pre-university education spans six years (the 7th to 12th grade), while higher general education lasts five years (the 7th to 11th grade). Rooted in sociology and political science, Dutch social science education emphasizes understanding and applying social scientific concepts (e.g., social inequality, socialization, individualization, and globalization) and SSR (College van Toetsen en Examens, 2019). Social science is a relatively new school subject in the Netherlands. The introduction of a new social science curriculum in 2017 emphasized a concept-context approach. The objective of this curriculum is for students to apply social scientific concepts as tools for analyzing current social problems (contexts) (Olgers et al., 2021).

Ten Dutch social science teachers participated in the professional development program. Active consent was obtained from the teachers, and approval was granted by the faculty ethics committee. The teachers were recruited through the researchers' professional network. All participants hold master's degrees in social sciences (primarily sociology and political sciences) and in teaching social sciences. The group varied in their years of teaching experience (see Table 3). However, the years of teaching experience might provide a somewhat skewed perspective for this study on teaching SSR, due to the significant renewal of the exam program in 2017. Teachers with five or fewer years of experience (Olivia, Hannah, Joe, Noah, Ezrah, and Jason) received explicit training in the new exam program during their teacher education, while more

Table 3
Overview of participating teachers.

Teacher[a]	Gender	Years of experience
Julia	female	12
Olivia	female	3
Layla	female	5
Hannah	female	1
Joe	male	4
Noah	male	3
Ezrah	male	1
Erin	female	14
Jason	male	2
Theodore	male	14

[a] Pseudonyms were used for the teachers' names in the study.

experienced teachers lacked this specific training.

All the teachers developed a lesson unit or assignment aimed at promoting students' SSR. They used various types of materials in their teaching practice; some adapted materials from the ECMs (such as sample lessons), while others created entirely new materials. Due to the COVID-19 pandemic, teachers often had to implement their lessons differently than originally planned. Four out of ten teachers participated in the follow-up interview one year later; one became a team leader, another transitioned to teaching at a Dutch university of applied sciences, and a third became a city council member. Additionally, three teachers were unable to participate due to personal circumstances, including emigration and illness.

3.2. Design of the professionalization program

In the Netherlands, most professional development programs for teachers tend towards the traditional, such as conferences and professional development days. These programs often lack situational relevance and do not directly address specific issues within teachers' teaching context. As a result, these activities rarely lead to sustainable changes in teachers' ideas, knowledge or practices (Van Cooten & Van Bergen, 2009; Van Veen et al., 2010; Vink et al., 2010).

The professional development program in this study was embedded in a professional learning community. The design of our program was informed by Desimone's (2009) insights and Clarke and Hollingsworth's (2002) model of professional growth. The ECMs were used as external sources of information or stimuli. According to the theoretical framework, teachers' learning in professional development is more effective when it is distributed over time (Garet et al., 2001; Penuel et al., 2007). Therefore, this program comprised six meetings spread over nine months. These meetings were facilitated by a team of experts, consisting of two social science teacher educators (including the first author) and a researcher (the second author). Due to COVID-19 restrictions, meetings 2, 3 and 4 were held online rather than in person. Figure 1 outlines the professional development program.

The first three meetings (October–December 2021) focused on establishing a shared knowledge base about SSR. The first meeting (in person, 8 h) centered on explaining SSR using all three ECMs. This involved introducing reasoning flaws and rubrics by using student reasoning samples and scoring excerpts from the rubric. Additionally, two of the four sample lessons (Lessons 1 and 2) and their design principles were modeled by the designers, and instructional videos were demonstrated and discussed. In the second meeting (online, 4 h), the designers modeled Sample Lessons 3 and 4. Participating teachers also brainstormed their initial ideas for their own practice, using the sample materials and design principles provided. The third meeting (online, 4 h) featured a presentation by a social science teacher educator on using social scientific concepts to promote SSR. Teachers also received feedback from the supervision team on their initial lesson designs.

During the three follow-up meetings (January–June 2022), the focus shifted to the teachers' own (re)designs of lessons aimed at promoting students' SSR. In the fourth meeting (online, 2 h), teachers developed learning tasks, and engaged in peer feedback on their provisional designs. In the fifth meeting (in person, 7 h), the teachers presented their lessons, explicitly connecting their materials to the ECMs and design principles. Time was allocated for finalizing their designs before implementation. In the sixth meeting (in person, 3 h), teachers shared their experiences with colleagues and experts, discussing student outputs. Furthermore, teachers evaluated the professional development program.

3.3. Data Collection

To examine teachers' professional growth, we collected data through questionnaires and interviews conducted before, immediately after, and one year following the professionalization program. The questionnaire and interview protocols were based on Clarke and Hollingsworth's (2002) interconnected model of professional growth. In the personal domain, we focused on knowledge and beliefs about SSR. Drawing on

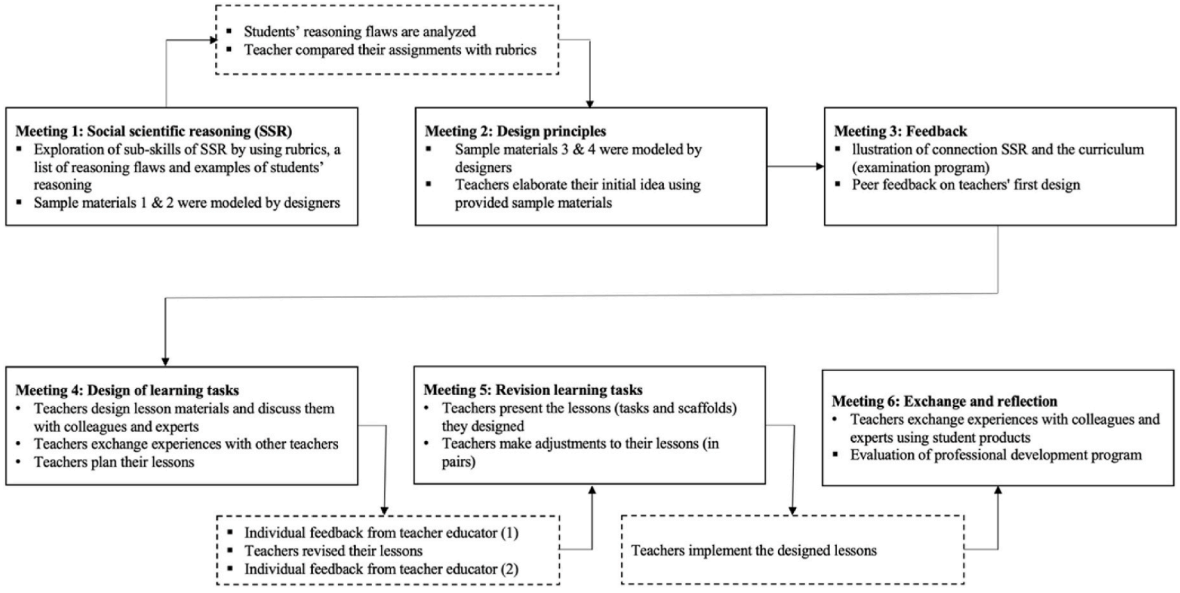


Fig. 1. Outline of the professional development program.

insights into teachers' pedagogical content knowledge (Fraser, 2015; Grossman, 1990; Magnusson et al., 1999; Shulman, 1986), we examined ideas about social science education objectives, teachers' perceptions of student learning, and instructional strategies for teaching SSR. These components were the main topics in both the questionnaires and interviews (see Table 4).

A key focus point of the interviews was evaluating the contribution of ECMs to teachers' professional growth. The semi-structured interviews mirrored the questionnaire structure but aimed to provide more in-depth explanations and examples. Teachers were asked to elaborate on their questionnaire response (e.g., "What do you mean by X? What is your understanding of Y?") and provide specific examples (e.g., "How is this observed in your classroom? What do students do or say to illustrate Z?"). We also conducted a follow-up interview one year after the program with the four teachers who remained active in their social science teaching roles. This interview focused on assessing the long-term impact on their beliefs, knowledge and practices. We examined which ECM materials were still used in their practice and which were not, and the reasons for these choices. Furthermore, lesson artifacts were collected and analyzed to construct a narrative profile of one teacher's professional growth.

3.4. Data analysis

All interviews were recorded and transcribed verbatim. The data from pre- and post-interviews and questionnaires were analyzed qualitatively. Following Zhang and Wildemuth's (2009) recommendations, we assigned codes to text segments that, regardless of length, represented meaningful units related to our research questions. We selected segments addressing the domains in which teachers reported changes and coded the sources of reported growth.

First, the data from the pre- and post-interviews were coded in ATLAS.ti based on the three components of the interview format: knowledge, beliefs, and instructional practice (see Table 5). These categories align with the domains of change in Clarke and Hollingsworth's interconnected model of professional growth (2002) and the pedagogical content knowledge components outlined by Magnusson et al. (1999).

Second, in the post-interview transcripts, we further coded sources contributing to changes in teachers' knowledge, beliefs, and practices. The ECMs, part of the external domain as defined by Clarke and Hollingsworth (2002), were specifically analyzed.

Table 4
Overview of theprimary topics in the questionnaires and interviews.

Domain of change	Main topic and underlying pedagogical content knowledge components	Sample question
Personal Domain	*Knowledge and beliefs related to:*	
	a. The objectives and nature of social science education (*knowledge of curriculum*)	How has this professionalization program influenced your understanding of SSR? Specifically, what new knowledge have you gained?
	b. Student learning in social science education (*knowledge of students' learning)*	What difficulties do students encounter? Can you provide examples of naïve reasoning observed in students?
	c. Instructional strategies in social science education (*knowledge of pedagogical approaches*)	How have the insights from the program altered your understanding of pedagogic approaches or principles?
Domain of practice	Classroom practices	Which SSR sub-skills were implemented more in your classes? What aspects would you like to emphasize further in your lessons?
External domain	Sources of learning	What sources and materials have been particularly beneficial, and what aspects did you gain from them?

Table 5
Coding scheme for interviews.

Domain of teachers' professional development	Subcategory of change	Sources for growth
A. Knowledge (of)	- A1. Sub-skills and levels of SSR - A2. Students' understanding of SSR - A3. Instructional strategies for teaching and assessing SSR	- ECM1: Rubrics defining components and levels of SSR - ECM2: List of flaws that occur in students' SSR - ECM3: Design principles for teaching SSR, with supportive sample lessons and instructional videos - Learning from and with colleagues - Learning from experts - Reflection on students' SSR performances[a]
B. Beliefs (about)	- B1. Sub-skills and levels of SSR - B2. Student learning in social science education - B3. Instructional strategies to teach and assess SSR	a
C. Instructional practice	- C1. Teacher skills related to teaching SSR - C2. Instructional strategies	a

[a] These sources of growth are also used as codes in domains B and C.

Subcategories included the different ECMs used in the professional development program: (a) Rubrics defining components and levels of SSR, (b) List of flaws in students' SSR, (c) Design principles for teaching SSR with supportive sample lessons and instructional videos. During the analysis, we also inductively coded other external sources identified by teachers as relevant to their professional growth, such as learning from experts (e.g., teacher educators and researchers) and learning from and with colleagues. Furthermore, we introduced the label "change through reflection on students' SSR performances" in our coding. This was added because we observed that changes in teachers' knowledge, skills, beliefs, and practice occurred based on students' performances, which aligns with Clarke and Hollingsworth's domain of consequence (2002). Table 6 provides examples of coding related to changes in teachers' knowledge (personal domain) and the sources of growth (external domain) that contributed to this change.

Finally, we created a narrative profile of one teacher, Julia, to explore the interconnectedness of professional growth in greater depth. Julia was selected because her development was representative of most other teachers in the study. Her profile was constructed from the interviews (see Tables 4 and 5) and was supplemented by an analysis of her designed teaching materials. We analyzed the lesson plans and teaching materials for explicit application or integration of the ECMs. Furthermore, we triangulated this analysis with Julia's comments on her lessons and practice from the post-interview and discussed our interpretations.

Examining the appropriateness of the inferences at each step of the analysis was a key concern (see Tracy, 2010). Throughout the research process, and following recommendations for ensuring trustworthiness (Amin et al., 2020; Guba, 1981; Lincoln & Guba, 1985), each step of the analytical process was thoroughly documented and critically discussed within the research team. Additionally, as recommended by Lincoln and Guba (1985), the third and fourth authors served as critical friends during peer briefing sessions. The research team discussed and refined codes and categorizations of quotes.

Table 6
Example from codebook Change of knowledge.

Domain of teachers' professional development	Subcategory of change	Example	Source of growth
A. Change in knowledge (of)	A1. Sub-skills and levels of SSR	"*Students find it very difficult to use the concepts. They often engage in "concept dropping," and the rubric helped me a lot in addressing this issue.*"	ECM1: Rubrics defining components and levels of SSR
	A2. Students' understanding of SSR	*"I now understand more about students' misconceptions and the criteria for assessing social scientific reasoning. I've also begun to view my answer models for inquiry tasks and tests differently."*	ECM2: List of flaws that occur in students' SSR
	A3. Instructional strategies to teach and assess SSR	"*What did I gain more knowledge about? For example, the[sample] lesson on social inequality, which I used directly in my classes. provided me with tools and helped me see the potential of social sciences beyond the existing method we were using, which I found too dull and not context-rich enough.*	ECM3: Design principles for teaching SSR, with supportive sample lessons and instructional videos

4. Results

First, we discuss changes in teachers' personal domain (knowledge and beliefs) and their domain of practice. Within these domains, we explore both the changes and the sources of these changes. Following this, we present the narrative of one teacher, Julia, and highlight patterns of her growth that are representative of the experience of the other participating teachers.

4.1. Personal domain: change in knowledge

Before the start of the program, most teachers described SSR in primarily vague and abstract terms. For example, Erin defined SSR as "a critical attitude of students based on knowledge and research skills," while Olivia described it as "teaching students to systematically analyze social problems." These descriptions were generally not specific to the subject. However, some teachers offered more concrete definitions. For example, Hannah emphasized that the goal of social science education is to analyze social problems from multiple perspectives, enabling students to "see beyond their own bubble." When asked what they hoped to learn from the program, the majority expressed a desire to improve their understanding of SSR, particularly regarding students' naive reasoning and misconceptions. Layla, for example, stated, "I find it difficult and time-consuming to make misconceptions visible, so I would like guidance on that."

Based on the analysis of the post-questionnaires and post-interviews, we identified two key shifts in teachers' knowledge about SSR. First, teachers reported acquiring more specific knowledge about the sub-skills within SSR and a better understanding of reasoning across different levels of SSR. Some teachers gained insights into students' difficulties through practical implementation. For example, Noah noted, "Testing out my materials has given me insight into what students find difficult." Similarly, Joe remarked, "It also clarifies what students are expected to master eventually." Teachers recognized that SSR is subject-specific, and by the end of the program, all teachers reported a clearer understanding of the indicators of higher levels of SSR.

Second, teachers gained a deeper understanding of students' reasoning flaws. Olivia, for example, noted, "They find it very difficult to use the concepts. They often engage in 'concept dropping' [the practice of naming concepts without fully understanding them], and the rubric helped me a lot in addressing this issue." Five teachers identified understanding reasoning flaws as the most significant change in their knowledge. Hannah, for example, highlighted "becoming aware of the many reasoning flaws in social science education" as a major insight. Noah emphasized the value of the list of reasoning flaws: "I found those so-called misconceptions very enlightening; all those different kinds of flawed reasoning." Teachers reported that this knowledge of reasoning flaws enabled them to better recognize and address these shortcomings in their practice.

4.2. Personal domain: change in beliefs

Before participating in the professionalization program, teachers' views on the core goals of SSR were diverse. Erin, for example, emphasized that SSR should "foster a critical attitude in students grounded in knowledge and research skills." Layla noted that SSR should enable "students to argue their perspective, requiring them to understand the topic and its nuances, and consider multiple perspectives." Noah believed that SSR should focus on "describing complex social issues objectively, moving beyond initial associations and gut feelings." These beliefs, although relevant, were often underdeveloped in subject-specific terms.

We identified three key changes in teachers' beliefs after the program: teachers became more convinced that SSR is subject-specific, complex, and challenging; they recognized the importance of scaffolding, and their views on effective pedagogical approaches shifted.

Teachers acknowledged the need to acquire more specific knowledge of SSR to develop effective teaching materials that promote student reasoning. They highlighted the value of using diverse examples and contexts to make abstract social science concepts more concrete. For instance, Ezrah observed, "You approach it differently … You look for contexts and examples more. I noticed that students enjoy it more." Teachers also became more convinced that students' preconceptions, feelings, and emotions play a significant role in their reasoning about social problems. Olivia highlighted the importance of considering students' opinions on current social problems: "I try to teach my students to look up facts, assess the reliability of the data, and separate facts from opinions."

Secondly, teachers became more aware of the importance of using scaffolds, particularly visual ones. Almost all the teachers emphasized the relevance of scaffolding, such as using cause-and-consequence diagrams. Layla noted, "I've become more aware of the need to use diagrams, such as the reasoning diagram and Coleman's Boat, and I plan to use them more often." Other teachers shared similar sentiments, recognizing that diagrams can facilitate a deeper analysis of complex concepts by distinguishing causes, consequences, and solutions, and linking the concept to meaningful examples, leading to more effective teaching. Teachers also mentioned other scaffolds as helpful. Olivia explained, "I'm now more conscious of the importance of scaffolding. You need to give students a helping hand, allowing them to progress at their own pace, rather than expecting them to jump from A to Z. By providing examples and opportunities for gradual progress, students can build their skills more effectively." This approach enables students to develop their SSR skills in a more structured and supportive manner.

The third change is that teachers' deeper understanding of SSR resulted in a shift in their beliefs about effective instructional approaches for promoting SSR. Specifically, teachers became more convinced that starting with concrete contexts rather than abstract

concepts is a more effective way to promote SSR. This approach aligns with the Dutch social science national curriculum's concept-context approach. Several teachers reported that applying concepts to real-world contexts facilitates deeper processing and understanding. For example, Joe noted, "Instead of starting with the subject matter, you start with 'how it works' in society, like dating apps, and then link it to rationalization." Others emphasized the importance of breaking down complex concepts into their constituent parts, such as "unraveling" definitions into variables, indicators, and or cause-and-consequence relationships. Overall, teachers became more convinced that subject-specific skills are more meaningful and effective when applied to authentic contexts.

4.2.1. Sources that contributed to changes in teachers' personal domain

Teachers attributed their reported change in knowledge and beliefs to the rubric and the list of reasoning flaws, particularly when used in combination. These tools provided teachers with a deeper understanding of the sub-skills involved in SSR and the challenges students face.

The rubric helped teachers recognize the domain specificity of SSR and the varying levels of reasoning expected from students. As one teacher noted, "The rubric gave me insight into the different skills but also made me realize how difficult reasoning can be for students" (Noah). Another teacher found the rubric—in line with the list of reasoning flaws—helpful in making SSR more concrete, stating, "It helped me to identify naïve ways of thinking and common misconceptions" (Ezrah).

The list of reasoning flaws was also widely used by teachers to gain a clearer understanding of specific aspects of students' SSR. One teacher described it as follows: "The list of misconceptions [reasoning flaws] is comprehensive. I couldn't have thought of them all myself" (Noah).

Although to a lesser extent than the rubrics and list of reasoning flaws, most teachers found the design principles for teaching SSR, along with supportive sample lessons and instructional videos to be helpful in making reasoning skills explicit. These resources benefited both students and teachers. As one teacher noted, "I had already mastered that [sub-skill] myself, but the instructional video still helped me get a clearer picture of what social science research is all about" (Jason). The sample lessons and underlying design principles played a significant role in shaping teachers' understanding of scaffolding, particularly in the use of diagrams and real-world contexts to promote reasoning. The sample lessons, which feature a range of elaborate scaffolds, served as a valuable source of inspiration for teachers in this regard.

4.3. Domain of practice

Before the professionalization program, teachers struggled to recognize and anticipate misconceptions and flaws in students' reasoning. They expressed a desire to better understand students' prior knowledge and conceptions, as well as to develop strategies for addressing these misconceptions. One teacher noted, "I find it difficult to determine what knowledge and conceptions students enter my class with. There are often big differences between students" (Layla). Teachers also wanted to provide higher-quality feedback on student reasoning.

Furthermore, teachers expressed a desire to make social science education, particularly SSR, more meaningful and engaging for students. Teachers felt that they lacked sufficient sample materials and ideas to make the subject more appealing and relevant. One teacher admitted, "I often get 'stuck' in simple explanations and lack examples to properly explain the importance and make it appealing to students" (Erin). Furthermore, teachers felt that the textbooks provided inadequate guidance and inspiration for promoting SSR, with one teacher stating, "Social science education is a relatively new subject to me, one in which I have little experience. Personally, I do not find the teaching method we use at school appealing, and there are no materials available in the team [of social science teachers] to use" (Olivia).

The teachers' responses revealed three significant shifts in their practices: identifying flaws in students' reasoning; providing better feedback to students to improve their reasoning, and explicit teaching of reasoning skills through a step-by-step approach. All teachers found it valuable to test their newly designed lessons in their practice. The professionalization program played a significant role in enhancing teachers' understanding of reasoning flaws.

The first change in practice among the participating teachers was their increased ability to identify flaws in students' reasoning. The professionalization program provided them with more tools to recognize and identify these flaws. For example, one teacher reported being better able to identify when students were using anecdotal evidence in their reasoning: "That was happening a lot in my classroom, a lot of 'N = 1 reasoning.' 'But sir, our generation doesn't do that.' For the following lesson, I found a study suggesting that younger generations are becoming increasingly conservative. So, I talked to them about that, asking, 'How does that contrast?' I have now become more aware that N = 1 reasoning is one thing you must address [in class]" (Joe). Similarly, another teacher illustrated how the program's impact on their knowledge led to a change in practice. "Because I can interpret it [SSR] better, I can also see it better. I can categorize it and point out specific errors, such as when students confuse causation and correlation or engage in 'concept dropping'. They often rely on gut feelings rather than facts, and therefore aren't yet able to make an informed assessment" (Olivia).

The second change is that four of the seven teachers reported becoming more skilled at providing feedback on student assignments that involve reasoning about social problems. One teacher noted that using the rubric made assessing assignments "a lot more reliable." However, teachers still struggled to provide targeted feedback, with one teacher stating, "I think it's essential to give students insight into their reasoning, where they stand and where they want to go. Although I haven't mastered this yet, it's a goal I aim to focus on in the coming years, as it aligns with our school's emphasis on formative evaluation" (Julia).

The third change in practice related to the participants' adoption of a more step-by-step approach to teaching SSR. Partially through the demonstrated sample materials, more teachers recognized the effectiveness of this approach, and more teachers began to incorporate it into their practice. One teacher noted, "The sample material on social inequality, which uses scaffolding to lead students step by step, gave me new ideas on how to approach this" (Olivia). Another teacher emphasized the importance of a step-by-step approach but acknowledged the ongoing challenges in applying this in practice: "I'm trying to help students reason by making the thinking steps and the overall task more insightful, not only by providing examples but also by using diagrams to make the thinking steps visible. I became aware of the importance of this during the professional development program, but I still find it challenging to implement it in my lessons" (Julia). However, one teacher expressed concern that a step-by-step approach to teaching SSR could potentially demotivate and discourage students.

4.3.1. Sources that contribute to changes in teachers' domain of practice

A key source of change for the teachers was experimenting with new pedagogical approaches, inspired by the sample lessons and underlying design principles. Both experienced and novice teachers incorporated these sample lessons into their practice, using concrete examples and contexts to promote reasoning. All teachers reported modifying their existing teaching materials based on the insights they gained about design principles for promoting SSR. The final assignments and lessons developed by the teachers varied in their adherence to the sample materials. Some teachers adopted the step-by-step approach from the sample lesson on social inequality, while others used it as a starting point to improve their existing assignments and make reasoning skills more explicit. Teachers adjusted their existing materials based on changes in their knowledge and the demonstrated ECMs used in the program. As one teacher noted, "I adapted my existing rubric for the

authentic assessment task to the one on SSR."

The rubric and list of reasoning flaws served as important sources contributing to teachers' change in practice. However, teachers used the rubric in different ways. One teacher, Olivia, used it as a source of inspiration: "I used it purely as a kind of 'wake-up call,' to get an idea of what's possible." Other teachers used the rubric in their practice as a feedback tool or to assess the robustness of students' reasoning. They also used it to formulate lesson objectives or improve their existing assignments. As Julia noted, "The rubric helped me improve my teaching materials." Teachers used the rubric for grading assignments and providing feedback on students' reasoning. Three teachers explicitly designated the rubric as the most powerful source of change in their practice, although they acknowledged room for improvement. Joe, for example, stated, "What I find most powerful is the rubric. It's a great thinking tool for teachers, and I used it to quickly check grades and provide feedback. While there's still room for fine-tuning, it's been really helpful." This quote illustrates that the change in teachers' beliefs was closely tied to a change in their practice.

Teachers also emphasized that combining the rubric and reasoning flaws was a key factor in their learning and teaching practice. As Olivia noted, "The professionalization program gave me insights into the reasoning errors students commonly make and also provided clarity on what students are expected to master. The rubric was particularly helpful in grading assignments and explaining to students why their reasoning wasn't complete or good." The combination of understanding the challenges students face (reasoning flaws) and having a clear picture of what constitutes average and excellent reasoning (by using the rubric) appeared to be a powerful catalyst for changing their teaching practice. In general, the ECMs were considered valuable sources that contributed to the teachers' professional growth. The teachers actively incorporated these materials into their own teaching practices.

4.4. Teachers' professional growth: one year later

One year after the professionalization program, the teachers reported that the knowledge and beliefs they had developed were still present. They continued to demonstrate a solid understanding of SSR and consistently used the ECMs which they had adapted to suit their needs. As Olivia noted, "What really stuck with me was the idea of 'concept dropping.' Once I became aware of it, I was able to review assessments more effectively. I was able to see that students were naming a concept without understanding its meaning, as evident from their follow-up answers." This finding is consistent with the changes in knowledge and beliefs observed in the interviews and questionnaires conducted immediately after the professionalization program.

Most changes in professional growth a year after the program appeared in teachers' practices, primarily driven by shifts in their knowledge and beliefs. As the teachers gained insight into students' SSR, their confidence in teaching this reasoning increased. One teacher expressed this as follows: "Social science was uncharted territory for me, and I was unsure whether I would be able to teach it at all. The professionalization program helped me realize I was on the right track. I now understand what is expected of me" (Ezrah). The rubric, list of reasoning flaws, and sample lessons with underlying design principles remained important sources of learning, while instructional videos were mentioned to a lesser extent. For example, Ezrah also noted that the program led to a change in his approach to social science lessons, stating, "Sometimes I revisit old lessons and realize they were static. Now, by using contexts and examples, I make the lessons more engaging for students."

All four teachers continued to use the teaching materials they had developed during the professionalization program, with some refining the materials after the program. Furthermore, all teachers reported regularly using the four sample lessons in their practice. One teacher used all four sample materials, though partially adapted, while the others used two or three. The sample materials or significant components were often integrated into the existing curriculum, with teachers making adjustments to better align with their teaching styles. "I used the sample lessons about decoding the news. I adapted it a little to fit my own style" (Julia). Two teachers mentioned using instructional videos in their practice to clarify specific SSR sub-skills for students.

One year later, all four teachers were still using the rubric. While it was partly used to provide feedback on students' SSR, it was primarily used to modify existing assessment models. One teacher mentioned using the rubric for "fine-tuning my assessment model" (Layla), which aligns with another teacher's comment: "I used the rubric in creating my own assessment model" (Julia). Additionally, two of the four teachers continued to use the list of reasoning flaws as a pedagogic tool, utilizing it to give students feedback on their reasoning.

4.5. Narrative profile of reported change in SSR: Julia

Our results revealed two primary patterns in teachers' growth in teaching SSR. The first pattern illustrated that changes in the external domain (subject-specific ECMs) resulted in changes in teachers' personal domains. These materials enriched teachers' knowledge and beliefs about SSR, such as the understanding that SSR is domain-specific. This highlighted the educative nature of the materials, demonstrating that teachers learned by enhancing their knowledge and beliefs. The second pattern showed that changes in the external domain resulted in changes in teachers' domain of practice and domain of consequence. The ECMs proved to be practical tools that teachers integrated into their lessons. During the professionalization program, teachers implemented the sample lessons, rubrics, list of reasoning flaws and instructional videos into their lessons.

To better understand how ECMs support professional change across the different domains, and how these domains interact, we explored the patterns in one participant's profile (Julia). The patterns observed in Julia's development reflected the development and changes reported by most participating teachers.

Julia has 12 years of experience as a social science teacher. In the questionnaire prior to the professional development program, she emphasized the importance of developing students' reasoning skills as a key goal of social science education. She also highlighted the need to make students' naïve beliefs and misconceptions visible and to encourage them to question these beliefs. However, Julia acknowledged that her teaching practice did not always align with her intended curriculum in these areas, stating, "I wonder to what extent I actually achieve this in my classes. In fact, I'm not really sure if my school's exams always assess this adequately."

After the professionalization program, Julia reported an increase in her knowledge about SSR and noted that the program had influenced her beliefs about reasoning in social science education. "I now think differently about what I am actually teaching my students. Instead of just teaching them what the core concepts [in social science education] mean and how to incorporate that into an answer, I have been focusing more on reasoning skills. I've realized that social scientific reasoning is actually a thing." Among other insights, Julia became convinced that SSR is indeed subject-specific.

Julia's reported growth began with changes in the external domain. She repeatedly emphasized that the rubrics contributed significantly to her professional development. The use of the rubrics during the professionalization program not only enhanced her knowledge and beliefs but also led to changes in how she assessed students' reasoning: "I think it's mainly reflected in how I started grading and assessing students' answers. I've become more aware of what good reasoning is and the necessary thinking steps that need to be taken. The professional development program really made me realize this." This example illustrates how changes in the external domain (the rubric) increased Julia's knowledge and beliefs about SSR (her personal domain). These changes in her personal domain had a direct impact on her domain of practice: she applied these new insights to her existing teaching materials and

teaching strategies. As she explained, "Before, when I checked an answer, I would look for certain words the students used. Now, I focus more on the connection they make between concepts."

A similar pattern of professional growth was evident in how Julia used the list of flaws observed in students' SSR. "I show them a list of reasoning flaws that I frequently see in my students' work and then give them sample answers from their own group, anonymously. They have to classify the reasoning flaw they see and then correct the answer." This mirrors the development seen with the use of the rubrics: after discovering the list of reasoning flaws (external domain), Julia gained deeper knowledge about the common mistakes students make (personal domain). This insight led to changes in her teaching practice: "I even use these reasoning flaws in my exam training for students as examples." Subsequently, Julia observed that this approach helped students learn from the feedback ("Oh, that could be a mistake, and that's how I should do it"). She noted that students began to recognize reasoning flaws in their own work and that of their peers. Ultimately, this led to improved learning outcomes (domain of consequence).

Julia's use of the list of reasoning flaws highlighted the dual purpose of ECMs: both students and teachers can benefit from these materials. Julia gained insights from the list of flaws and then incorporated it, with some modifications, into her teaching practice to help students learn from it as well. Furthermore, Julia noted that she also made extensive use of the sample lessons with underlying design principles and some instructional videos, both immediately after the program and a year later. She emphasized that she adapted the sample materials to align with her teaching practice and style: "The sample lessons on using statistics with current social problems: I adapted it a bit to my own style."

The impact of the design principles was evident in the teaching materials Julia designed during the professionalization program. In these materials, students analyzed the relationship between generations, social classes, environmental factors, and value orientations using the provided resources. Several design principles emphasized in the ECMs were incorporated into these materials. For example, Julia chose a context (comparing generations) that encourages curiosity and practices social scientific reasoning. Students compare their own generation with that of their parents and grandparents, addressing preconceptions about their own generation, how it is portrayed in various media and their own perspectives. This approach aligns with the SSR design principle of making the development of students' SSR transparent by considering their initial associations, prior knowledge, and intuitive responses (Design Principle 1, see Table 2). Julia's teaching materials also reflected components from the rubric, such as "distinguishing causes" and "connecting causes and consequences". For example, students compare generational characteristics, learn to identify and differentiate between causes and consequences and recognize various environmental factors with concrete examples. The use of diagrams and scaffolding also supports students' reasoning by requiring them to identify influencing variables from given sources (e.g., research data) and use a diagram (conceptual model) to connect these variables derived (Design Principle 5).

Reflecting on the implementation of this material offered valuable new insights. This process aligns with Julia's previously described professional growth: changes in the external domain (including sample materials with design principles and rubrics) led to reported shifts in her knowledge and beliefs. These changes were then translated into new teaching activities (within the domain of practice). As Julia implemented these adjustments, she observed the elaborations and reactions of her students (within the domain of consequence). For example, when Julia noticed that students encountered difficulties with a specific SSR sub-skill during an assignment, she decided to incorporate an instructional video from the professionalization program. She explained, "The initial instruction was to work with those sources, and the students found that particularly difficult. Then, in a later lesson, I took that example from the video on the slide and reviewed it in class to provide clarification."

In summary, our detailed examination of Julia's reported growth reveals that the changes in the external domain significantly contributed to her professional development across both the personal domain and the domain of practice. The ECMs stimulated shifts in knowledge and beliefs related to SSR, which, in turn, impacted Julia's teaching practice. Fig. 2 visually illustrates this pattern, specifically focusing on Julia's use of the list of reasoning flaws observed in students' SSR.

As previously mentioned, the patterns observed in Julia's professional growth align with the development seen among all participating teachers. All the teachers reported changes in knowledge and beliefs through the use of subject-specific ECMs, which in turn influenced their teaching practice. For example, Ezrah—a novice teacher with one year of experience in social science education at the program's outset—actively incorporated all the ECMs in his teaching practice, particularly emphasizing the sample lessons with underlying design principles. As a result, his beliefs about teaching SSR evolved, which is reflected in the following remark: "There is actually no point in starting with the concept … that doesn't appeal to students. For example, the concept of social institutions. Am I going to explain that first? No, that doesn't work. I will start with examples to make it more meaningful." Ezrah emphasized having gained diverse insights from the professionalization program. While both Julia and Ezrah frequently utilized the materials, their approach to ECM usage differed. Julia customized and adapted the materials to her specific assignments and teaching context, whereas Ezrah, as a novice teacher, integrated the materials more directly into his teaching practice with minimal modifications.

5. Conclusion and discussion

The purpose of this exploratory study was to investigate how subject-specific ECMs used in a professionalization program contribute to teachers' professional growth in teaching SSR within social science education. In general, the ECMs employed in the professional development program were considered important sources that enhanced teachers' knowledge, beliefs and instructional practice. Teachers actively integrated these materials into their own teaching practice, resulting in noticeable changes in their teaching approaches. These findings offer valuable theoretical insights into the nature and use of ECMs (Davis & Krajcik, 2005), and contribute to our understanding of teachers' professional growth (Clarke & Hollingsworth, 2002; Magnusson et al., 1999).

Our study revealed shifts in teachers' pedagogical content knowledge and related beliefs. We found that the participating social science teachers increasingly recognized that SSR is complex, challenging, and subject-specific. Effective instructional strategies included explicitly addressing SSR steps and higher-order reasoning for students, as well as embedding instruction in meaningful contexts. All teachers reported a deeper understanding of SSR skills and the necessary steps for students to reach higher levels of reasoning. This increased knowledge proved valuable for formulating learning objectives, grading assignments, and providing feedback. Additionally, SSR received heightened attention in their lessons.

We can conclude that, consistent with Clarke and Hollingsworth's (2002) interconnected model of professional growth, changes in teachers' practice correlate with shifts in their knowledge, beliefs, and the processes of reflection and enactment. The subject-specific ECMs (introduced by teacher educators with expertise in teaching SSR) facilitated and supported reflection on the nuances of SSR instruction, as well as experimentation with alternative instructional strategies and feedback methods. For example, the rubrics that define components and levels, along with the list of flaws observed in students' SSR, contributed to teachers' understanding of SSR's complexity and domain-specific elements. Consequently, teachers became better equipped to recognize reasoning flaws in their own practice and provide more targeted feedback to students.

One component of pedagogical content knowledge involves teachers

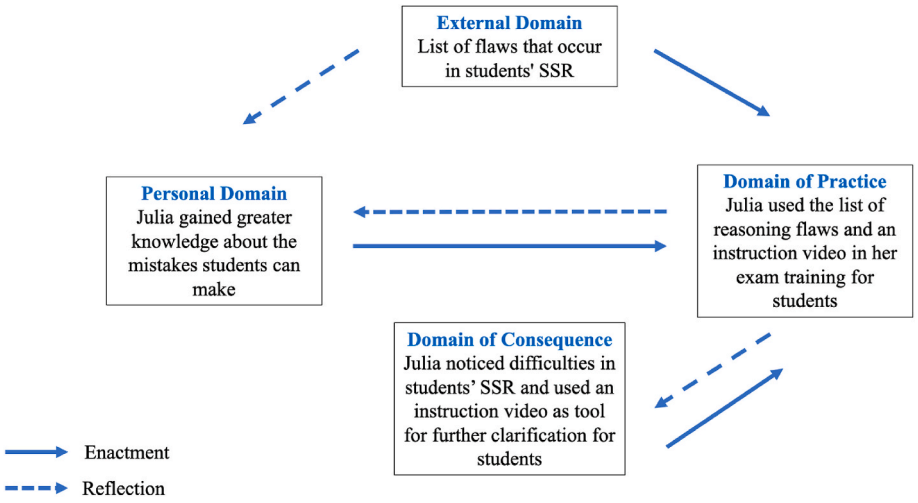


Fig. 2. Illustration of Julia's reported professional growth, as framed by Clarke and Hollingsworth's (2002) model, through her utilization of the list of reasoning flaws.

gaining insights into students' difficulties. Our results revealed that the list of flaws observed in students' SSR can guide teachers in understanding what students find challenging. Teachers actively apply this knowledge in their practice, particularly when providing feedback. While scholars often emphasize focusing on students' abilities rather than limitations, our research underscores the importance of teachers' awareness of students' difficulties when teaching a complex skill like SSR. Notably, a novice teacher from the program reported suddenly recognizing various reasoning flaws within her classes, highlighting the relevance of this knowledge for identifying students' SSR challenges.

In this professionalization program, the rubric served as a widely used feedback tool. This aligns precisely with the rubric's intended purpose: to provide teachers with an instrument for extracting and refining their own assessment or assignment tools. Importantly, this purpose mirrors that of ECMs, which aim to facilitate learning for both students and teachers (see Davis & Krajcik, 2005). While previous research often emphasized ECMs related to learning activities and teaching strategies, our study highlighted the value of other ECMs—specifically, the rubrics and the list of reasoning flaws. These subject-specific materials served as powerful ECMs, supporting the development of teachers' knowledge and beliefs (within the personal domain) and enhancing their teaching strategies (within the domain of practice). Additionally, they contributed to the development of teachers' pedagogical content knowledge. Even one year after the conclusion of the professionalization program, teachers continued to view these materials as potent resources that positively impacted their teaching practice, particularly in promoting students' SSR. Teachers incorporated the rubric, sample lessons, and assignments into their teaching practice in diverse ways.

While teacher professionalization programs in The Netherlands are often characterized as more traditional, such as conferences and professional development days (Van Cooten & Van Bergen, 2009; Van Veen et al., 2010; Vink et al., 2010), our study revealed that the use of subject-specific ECMs (external domain) served as a starting point for teachers' growth across other domains. Interestingly, these materials proved valuable for teachers with varying levels of experience. These insights contribute to our understanding of effective teacher professionalization programs.

5.1. Limitations and Suggestions for future research

In accordance with the criteria of trustworthiness proposed by Lincoln and Guba (1985), it is essential to emphasize that the conclusions drawn from our study are based on self-reported changes. We did not directly observe changes in either teachers' or students' SSR skills. For future research, observing social science classrooms both before and after a similar professionalization program could provide valuable insights.

Another limitation of this study pertains to the domain of consequence. Specifically, we did not focus on assessing the extent to which students' reasoning improves. Although insights into students' reasoning about social problems are relevant, they remain scarce, and valid assessments for measuring students' reasoning abilities are lacking. Future research could address this gap by constructing instruments that measure the complex skills related to SSR.

In this study, we were particularly interested in investigating the potential impact of subject-specific ECMs on teachers' reported growth. Therefore, our focus centered on the external domain as a potential starting point for professional growth. However, prior research has highlighted that other influential factors, such as peer learning and lesson observation, can also be a powerful source of learning. This has received less attention in our program. For future research, exploring these additional factors—especially in conjunction with ECM usage—could provide valuable insights.

A year after this program, the teachers reported that the ECMs continued to impact their teaching practices. This suggests that such materials can indeed have a robust impact on teachers' professional growth. However, it is worth noting that only four teachers participated in these follow-up interviews. Accordingly, we recommend further research on the longer-term effects among a larger group of teachers. Additionally, consideration can also be given to how teachers can be supported over an extended period, especially since some teachers expressed a need for more practice in implementing effective strategies.

While we anticipated that instructional videos would be useful, relevant, and desirable for enhancing SSR sub-skills among teachers, they were mentioned less frequently as impactful resources for professional growth. One possible explanation is that videos are challenging to adapt and less flexible in practice compared to the use of rubrics or design principles. Further research is necessary to explore whether providing specific examples of how instructional videos can be effectively used in teaching SSR might enhance their effectiveness as ECMs.

5.2. Implications for practice and policy-making

Our key contribution to educational practice lies in demonstrating that the use of subject-specific ECMs within a professional development program enhances teachers' professional growth in teaching reasoning skills within social science lessons. The rubric, list of reasoning flaws in

students' SSR, sample lessons, and design principles can all find application in secondary schools' social science education and teacher training programs at universities. By leveraging these resources, novice teachers can quickly assess students' reasoning levels and identify flaws, allowing them to adjust their teaching strategies accordingly. Teacher educators can incorporate these insights to strengthen their professionalization efforts in teaching SSR skills.

To adequately prepare students for understanding and analyzing complex social problems, teachers must possess the necessary knowledge, beliefs, and teaching skills within social science classes. We emphasize the significance of further developing domain-specific prototype materials that enhance teachers' knowledge and skills. These materials should not only support instructional strategies but also align with curriculum goals and address students' difficulties. Moreover, it is crucial to systematically integrate these resources, not only within professional learning communities but also in teacher training programs. Following international recommendations for educational policy on civic reasoning (Lee et al., 2021), achieving this requires schools and teachers to have sufficient time and facilitation. Ultimately, these efforts could lead to improved social science education and enhance students' ability to reason about social problems.

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CRediT authorship contribution statement

Thomas Klijnstra: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Gerhard L. Stoel:** Writing – review & editing, Methodology, Conceptualization. **Geerte M. Savenije:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization. **Carla A.M. van Boxtel:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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