These tasks are very good but inappropriate for my students

Odd Tore Kaufmann

These tasks are very good but inappropriate for my students

Odd Tore Kaufmann

Østfold University College, Faculty of Education, Halden, Norway; odd.t.kaufmann@hiof.no

This paper investigates how teachers reflect on and explain the role of high-quality mathematical tasks when selecting tasks for use in lessons. By analysing data from three groups of mathematics teachers engaged in collegial discussions, this study aims to elucidate how teachers rationalize the role of high-quality mathematical tasks. The results indicate that teachers appreciate high-quality tasks in providing discussions among students and supporting the collaborative efforts to solve problems. Conversely, despite this appreciation, teachers refer to such tasks as inappropriate for their students. For this reason, they pointed to the capabilities, lack of motivation to engage, and the lack experience of their students.

Keywords: Professional development, collegial discussion, high-quality tasks.

Introduction

The reform movement in mathematics education, which emphasizes the learning of additional mathematical competencies apart from procedural fluency, typically encourages the development and reorganization of syllabi, curriculum materials, and classroom practices. A central policy initiative that facilitates change frequently involves professional development (PD), which aims to support teachers in establishing productive classroom practices. A typically important component of such PD programs is the collegial discussions of teachers (Cobb & Jackson, 2011; Cobb et al., 2018). Within PD programs, collegial discussions may be viewed as a means for facilitating teacher development, which, in turn, is conceptualized as a means for improving and changing classroom practices (Desimone, 2009). According to Munter (2014), collaborations between teachers are less effective unless they share vision of high-quality instruction that gives meaning and purpose. High-quality instruction can be defined in three related dimensions of classroom instruction (Munter, 2014). The first is the role of the teacher, where the teacher supports students in learning mathematics by facilitating understanding. The second is developing a classroom community. Teachers are responsible for orchestrating discussions, such that students can share multiple problem-solving strategies, analyse relationships among strategies, and explore contradictions in ideas to provide more insight into mathematical thinking. The third dimension is the role of mathematical tasks. High-quality tasks should support students in developing problem-solving strategies (Hiebert et al., 1997) and should hold the potential to "engage students in solving challenging, ambiguously defined problems without the suggestion of a particular procedure or path to a solution" (Munter, 2014, p. 607). A central aspect of a concept labeled "ambitions instruction" (Kazemi et al., 2009) is using cognitively demanding tasks to challenge students. Engaging students in cognitively demanding and challenging tasks is characteristic of a reform-oriented approach to mathematics instruction. The study focuses on the third dimension, that is, the role of mathematical tasks and, specifically, how teachers rationalize the role of mathematical tasks in collegial discussions as they engage with a PD program in mathematics education. Investigating the explanation of teachers regarding the role of mathematical tasks when selecting tasks to use in lessons is important for understanding their reflection on the role of mathematical tasks. In this context, the following research question guides this paper: "How do three groups of teachers, who are participating in a PD program in Sweden,

rationalize the role of mathematical tasks in collective planning with colleagues?" I seek to answer this question by analysing three groups of mathematics teachers engaged in collegial discussions as part of a national large-scale PD program in Sweden. In the context of the current study, I understand collegial discussion in a pragmatic manner. In other words, when teachers work in teams with the support of the large-scale program, the boost in mathematics is designed to support such groups of teachers to engage in collegial discussions regarding resources as well as planning lessons and collective reflections on classroom instruction.

Relevant research

The notion of high-quality or challenging tasks is relatively common (Ingram et al., 2020). Through tasks in the mathematics classroom, compared with other methods, opportunities to learn are made available to students (Munter, 2014). Therefore, considering the mathematical ideas behind a task, the potential to engage students in solving such challenging problems, and possible solutions, strategies, and misconceptions that students may provide when attempting to solve a task is important prior to teaching (Munter, 2014). Based on the importance of high-quality tasks in mathematics teaching and learning, scholars have investigated the justification and characterization of teachers regarding the tasks they opt to use in terms of the potential of the task for students' work. For example, Heyd-Metzuyanim et al. (2019) interviewed two teachers as they participated in a PD program. The authors found that the main justification of teachers for selecting tasks was their location in a certain place in the curriculum, instead of mathematical goals. Another justification for selecting a task was that the task would lead to a discussion. However, the two teachers did not explicate the nature of this discussion during the interview. Through analyses of teacher interviews, Sun (2019) examined the beliefs of four teachers about mathematical tasks. The author found that their beliefs are frequently related to the concept that certain forms of mathematical activity are not viable for certain groups of students due to their different innate abilities. Thus, students with low achievement tend to be excluded from engaging in high-quality tasks.

Researchers also distinguish between high- and low-quality tasks. Cobb et al. (2018) investigated the aspect required to support the development of ambitious instructional practice among teachers. One of Cobb et al.'s. (2018) perspectives in this large-scale PD program was the nature of the task. One distinction is whether a task is of low or high cognitive demand. For tasks with low cognitive demand, students apply known procedures. Thus, little ambiguity exists in solving such tasks. High-cognitive tasks are frequently open-ended and can be solved using various strategies. In other words, students tend to struggle with such tasks for a certain period without intervention from the teacher. One of the findings by Cobb et al. (2018) was that maintaining the cognitive demand of a task is challenging for teachers. As a result, they frequently reduce the challenge of the task over the course of the lesson. Their views on high-quality tasks are that these tasks do not align with their structure of the lesson. Moreover, these tasks are considered inappropriate for the students. Munter (2014) developed a framework for characterizing the perceptions of teachers toward high- and low-quality tasks on the basis of more than 900 interviews. In this manner, he modeled the trajectories of the perceptions of high-quality instruction along the findings in the literature. At the lowest level, teachers fail to view tasks as being of high or low quality. At the next level, the responses of teachers suggest that tasks can vary in quality. However, those performed by the students should first enable procedural practice before problem-solving and application. At the third level, teachers refer to more sophisticated

descriptions of high-quality tasks, such as tasks that require multiple solutions or support the conceptual understanding of students. At the highest level, teachers refer to the rationale that high-quality tasks support students in learning and doing mathematics, such as making and testing conjectures, opening up for examining, and comparing several strategies. To better understand how teachers discuss and reflect on the role of mathematical tasks, I have opted to focus on the collective planning of teachers with colleagues during a PD project.

Method

The Swedish National Agency for Education launched a curriculum-based PD project. Called "Boost for Mathematics[1]" (Skolverket, 2018), this project intends to improve the teaching of mathematics. Its major components are 24 modules, where eight are disseminated per grade level (1–3, 4–6, and 7–9). Each module focuses on certain mathematical contents, the manner in which students learn these contents, and how teachers can support learning. A central part of these modules is high-quality tasks.[1] Each module presents several high-quality tasks and encourages teachers to discuss these tasks, such as selecting which ones to use in lessons and adjusting the task to be suitable for their class. The curriculum, which is distributed digitally on a website, includes articles, instructions, high-quality tasks, and videos. Each module is designed to support groups of teachers in engaging in eight iterations, comprising individual preparation, conducting collective planning with colleagues, teaching individual classrooms, and facilitating collective reflections in classroom instruction. This study focuses on the collective planning of teachers with colleagues at three selected schools. The selection process was based on two factors. Selecting one group of teachers from each of these three grade levels was convenient, because the data material was intended teachers from each grade level (i.e., 1–3, 4–6, and 7–9). The other process of selecting groups was including groups that opted to study the module in terms of problem-solving, which included high-quality tasks. Data were collected by videotaping two meetings with each group for a total of six sessions. The first meeting was based on collective planning with colleagues during the first semester, whereas the second was based on collective planning with colleagues during the second semester.

Analysis

To understand what teachers engage in when focusing on high-quality tasks in collegial discussions, as previously described, I have chosen to deeply examine the collective planning of the three groups of teachers for their classroom instruction. As part of data reduction, I identified and transcribed all discussion episodes that involved the teachers in the discussion of tasks. For analysis, I defined an episode of pedagogical reasoning as a coding unit:

> Units of teacher-to-teacher talk allow teachers to exhibit their understanding of an issue in their practice. Specifically, episodes of pedagogical reasoning are moments within teachers' interactions in which they describe issues in, or raise questions about, teaching practices that are accompanied by some elaboration of reasons, explanations, or justifications. (Horn, 2007, p. 46)

Episodes of pedagogical reasoning, in which the teachers explicitly discussed the tasks presented in the PD, were analysed. The abductive process was used to develop the analytical framework for the research (Bryman, 2016). Inspired by the framework of Munter (2014), I made modifications to their

1 The modules and the high-quality tasks: https://larportalen.skolverket.se/#/moduler/1-matematik/alla/alla

categories to create a total of three categories. Developing the analytical framework has been a continuous process, which required moving back and forth between the data and the analytical framework. Gradually, I made clear distinctions between different categories with a focus on entire episodes of the discussions among teachers regarding high-quality tasks. Munter (2014) categorized the different views of teachers about high-quality tasks. At the first level, they are aware that tasks can vary in quality; however, students require procedural practice before working with high-quality tasks. In the data material, several utterances occurred about the difficulties, limitations, and inabilities of students in working with high-quality tasks. These utterances were categorized as appropriateness for the students. At the next level, the teachers described the nature of tasks as being oriented toward reform. However, they fail to describe a function or describe it in terms of increasing interest levels and student engagement (Munter, 2014). Moreover, teachers were concerned about leisure gained from tasks and their potential to lead to discussions. Such views were categorized as the function of tasks. At the highest level, Munter (2014) described the view of teachers about high-quality tasks to support student learning and performing mathematics and to provide content for the entire class discussion. In the data material, the teachers were concerned about the structure of the lesson and the presentation and discussion of tasks across the phases of the lesson. These concerns were, therefore, categorized as the structure of the lesson. The results section provides further elaboration on these categories. Table 1 demonstrates the overview of schools and number of episodes identified for each category.

Table 1: Analysis of video materials — an overview

School (pseudonyms) and modules	Teachers (pseudonyms)	Video-Recorded Meetings.	Function of tasks	Structure of lessons	Appropriateness for students
Rafford 1–3. Problem-solving and number sense	Amy, Maria, Helen, Grace, Julie, and Hannah	First session: 50 min. Second session: 49 min.	3	5	12
Hadlow 4–6. Problem-solving and number sense	Mary, Mona, Celia, Fred, Josie, and Nicole	First session: 83 min. Second session: 55 min.	3	5	6
Padstow 7–9. Problem-solving and teaching mathematics using IT.	Emely, Michael, Lily, Tyler, and Stella	First session: 63 min. Second session: 57 min.	5	3	9

Results

This section presents an elaborate characterization of the rationalization of the three groups of teachers with regard to high-quality tasks during their participation in the PD program for mathematics education. The results from the three teacher groups were combined and discussed in

the following sections in terms of appropriateness for students, the function of tasks, and structure of lessons.

Appropriateness for students

This category was the most dominant when the teachers discussed high-quality tasks. Although the teachers agreed that high-quality tasks are beneficial, because they support the conceptual understanding of students and enable multiple solutions, they were relatively concerned regarding whether the tasks were appropriate for students. Nearly all arguments involved these tasks as being extremely difficult for students. I categorized these arguments of the appropriateness of high-quality tasks, which resulted in five aspects, namely, 1) students are only concerned with one correct answer and are satisfied when they arrive at a solution; 2) students do not challenge themselves but want an immediate answer; 3) students lack the patience to work on a task over time; 4) students are *locked* and unable to *think outside the box*, an aspect frequently required by such tasks; lastly, 5) students are preoccupied with the mathematics textbook and believe that all work apart from those that involve the textbook is not mathematics. For these reasons, the teachers explained that the students are unwilling to work with high-quality tasks. The following excerpt illustrate teachers refer to students being extremely *locked* and unable to *think outside the box*:

Mary: What about these tasks? How do you think the students are able to place a number of given fractions on a number line? What would it look like in your groups? Are they able to put them on a number line?
Mona: I think this is very difficult, at least for my students. Many of these tasks, it feels like it's too high a level. So, it's good for us to think, maybe, but it's not, not for my students anyway, so it feels too difficult.
Celia: No, it's too difficult.
Mary: Is it too difficult?
Fred: Yes. And my students are too locked, they'll get stuck, they're not able to think outside the box.

Mary raises an issue about her students' ability to mark fractions on a number line. This scenario is viewed as extremely difficult for Mona's students with agreement from Fred and Celia. The difficulty is partially related to the students' abilities and partially to the high level of task difficulty. As Fred mentioned, these students are too locked and unable to think outside the box, which Fred believes is a demand of such high-level tasks.

Function of tasks

The teachers presented three main arguments regarding the function of tasks. Two of these, which are the most common, are that the tasks should be fun for students and that the tasks should lead to and open discussions. In these categories, the teachers did not emphasize how these tasks can support the learning of mathematics. In one case out of all arguments, however, they discussed how tasks can support student learning, which is illustrated by the following excerpt:

Stella: We want to capture students' knowledge, whether they know this or that. Then we should choose the tasks based on that, I think, what we should work on or think that we benefit from getting to know about them. What gives us the most. How I as a teacher have intended to continue working, so that I choose a task that suits how I think I can continue working with it later.

In this case, Stella is looking for assignments that reveal the knowledge of students in mathematics and how the assignment can be used as a starting point for a further understanding of mathematics. This excerpt is an exception to the arguments that the teachers made regarding the function of tasks. The most common argument was that the tasks should be fun and motivating for the students, as shown in the next excerpt:

Josie: This one might not be so exciting for them, so they should … this with decimals, they should just …. I think they would think this was cool.

This case is an example of the fairly common argument that teachers use tasks that they consider fun for students. Thus, no argument was raised about the type of mathematics that students should work with or how the tasks can lead to learning.

Structure of lessons

A three-phase classroom activity structure, namely, the phases of introduction, students working on mathematical tasks, and finalizing the lesson, was recurrent in the collegial discussions. The teachers frequently referred to this structure as introduction, pair or alone, and all. According to Jackson et al. (2013), a common lesson structure in a reform-oriented mathematics curriculum is the three-phase lesson (which these teachers refer to), where a complex task is introduced, students work on solving it, and the teacher orchestrates a conclusive discussion with the entire class. This structure is typical of lessons in PD. These descriptions of the classroom structure espouse the reform-oriented view on the structure of lessons, although such characterizations may fail to describe the introduction of the task and the content of the interaction among students. According to the content of the interaction, the teachers are more concerned about holding a discussion or the tasks leading to a discussion instead of the quality and content of the discussion based on high-quality tasks. Furthermore, in the discussions, they frequently emphasized lowering the cognitive demand for high-quality tasks during their introduction:

Helen: Actually (...) what should I do, should we do a problem first together or should we just (..).
Amy: Don't you think yours (students) can do one?
Helen: Yeah, some of them.
Hannah: Mmm (...) mine are rather weak.
Helen: But eh (Amy (C): mm), yes but we'll do one, we'll formulate a problem based on an image.
Maria: Yes, you do a similar problem then (Hannah: mm).
Julie: With your group.
Maria: So they (Helen: mm) have a similar (...) structure to follow (Hannah: mm).

Helen expresses concern about whether the students should tackle tasks/solve problems immediately or if the lesson should start with an introduction. The teachers plan to introduce a problem based on arguments about the capacity of the students and the necessity for a teacher to provide structure for them. Other studies (e.g., Boston & Smith, 2009) have demonstrated that teachers experience difficulty in maintaining the cognitive demand of tasks during teaching. As seen in this example, the teachers are concerned about the difficulty of high-quality tasks. Therefore, they decide to lower the cognitive demand of the task to ensure that each student has the opportunity to work with it.

Discussion and conclusion

This article contributes to research on the collegial discussions of teachers engaged in a PD program on teachers' development as a process of change toward a reform-oriented educational practice (Cobb et al., 2018; Jackson et al., 2013). Specifically, this study adds to the literature by highlighting the views of teachers about high-quality tasks. Analysis indicates that the teachers are relatively ambivalent about using high-quality tasks in their lessons. On the one hand, they share certain elements of high-quality instruction that are aligned with the reform-oriented teacher practice. In other words, they emphasize and appreciate high-quality tasks as they correspond to their structure of the lesson according to the three-phase lesson structure called introduction, working together in pairs or alone, or both and summaries the lesson in whole-group discussions (Jackson et al., 2013). Within this lesson structure, the teachers are aware of the value and importance of high-quality tasks in promoting discussions among students and supporting their collaborative efforts to solve problems without relying on the teacher for explanations or to offer solution strategies. They emphasize high-quality tasks, because such tasks will support students' discussions better than low-quality tasks. Such discourse communities are unlikely to develop unless students gain opportunities to engage in rich mathematical work, which is typically initiated by a high-quality task (Munter, 2014). This notion forms part of a reform-oriented classroom practice (Cobb et al., 2018). An important aspect of reform-oriented teacher practice is the use of cognitively demanding tasks (Kazemi et al., 2009). On the other hand, although these teachers appreciate high-quality tasks, they stated, nearly in unison, that they referred to such tasks as inappropriate for students. For this reason, they blamed the capabilities, lack of motivation to engage, and lack of experience of their students with such tasks. The teachers' discussion about the role of high-quality tasks may be helpful in understanding their potential for learning in collaborative meetings to improve and change classroom practices (Desimone, 2009). The current findings reveal an ambivalent vision regarding high-quality tasks in relation to the reform-oriented teacher practice (Jackson et al., 2013). Such ambivalent views may influence the potential offered by implementing the reform-oriented classroom practice, given that teachers hold an unproductive framing of the capabilities of their students (Jackson et al., 2017; Sun, 2019).

References

Boston, M. D., & Smith, M. S. (2009). Transforming secondary mathematics teaching: Increasing the cognitive demands of instructional tasks used in teachers' classrooms. *Journal for Research in Mathematics Education,40*(2), 119–156. https://doi.org/10.2307/40539329

Bryman, A. (2016). *Social research methods.* Oxford university press.

Cobb, P., & Jackson, K. (2011). Towards an empirically grounded theory of action for improving the quality of mathematics teaching at scale. *Mathematics Teacher Education and Development, 13*(1), 6–33.

Cobb, P., Jackson, K., Henrick, E., & Smith, T. M. (2018). *Systems for instructional improvement: Creating coherence from the classroom to the district office.* Harvard Education Press.

Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher, 38*(3), 181–199. https://doi.org/10.3102/0013189X08331140

Heyd-Metzuyanim, E., Smith, M., Bill, V., & Resnick, L. B. (2019). From ritual to explorative participation in discourse-rich instructional practices: a case study of teacher learning through professional development. *Educational Studies in Mathematics*, *101*(2), 273–289. https://doi.org/10.1007/s10649-018-9849-9

Hiebert, J., Carpenter, T. P., Fennema, E., Wearne, D., Murray, H., & Human, P. (1997). *Making sense: Teaching and learning mathematics with understanding.* Heineman.

Horn, I. S. (2007). Fast kids, slow kids, lazy kids: Framing the mismatch problem in mathematics teachers' conversations. *Journal of the Learning Sciences*, *16*(1), 37–79. https://doi.org/10.1080/10508400709336942

Ingram, N., Holmes, M., Linsell, C., Livy, S., McCormick, M., & Sullivan, P. (2020). Exploring an innovative approach to teaching mathematics through the use of challenging tasks: A New Zealand perspective. *Mathematics Education Research Journal*, *32*, 497–522. https://doi.org/10.1007/s13394-019-00266-1

Jackson, K., Garrison, A., Wilson, J., Gibbons, L., & Shahan, E. (2013). Exploring relationships between setting up complex tasks and opportunities to learn in concluding whole-class discussions in middle-grades mathematics instruction. *Journal for Research in Mathematics Education*, *44*(4), 646–682. https://doi.org/10.5951/jresematheduc.44.4.0646

Jackson, K., Gibbons, L., & Sharpe, C. J. (2017). Teachers' views of students' mathematical capabilities: Challenges and possibilities for ambitious reform. *Teachers College Record*, *119*(7), 1–43. https://doi.org/10.1177/016146811711900708

Kazemi, E., Franke, M., & Lampert, M. (2009). Developing pedagogies in teacher education to support novice teachers' ability to enact ambitious instruction. In Hunter, R., Bicknell, B., & Burgess, T. (Eds.) *Crossing divides: Proceedings of the 32nd annual conference of the Mathematics Education Research Group of Australasia* (Vol. 1, pp. 12–30).

Munter, C. (2014). Developing visions of high-quality mathematics instruction. *Journal for Research in Mathematics Education*, *45*(5), 584–635. https://doi.org/10.5951/jresematheduc.45.5.0584

Skolverket (2018). *Matematiklyftet [Boost for Mathematics]*. Retrieved from https://larportalen.skolverket.se/#/moduler/1-matematik/alla/alla

Sun, K. L. (2019). The mindset disconnect in mathematics teaching: A qualitative analysis of classroom instruction. *The Journal of Mathematical Behavior*, *56*, 100706. https://doi.org/10.1016/j.jmathb.2019.04.005