HOW CAN A SETTING INFLUENCE ONE'S REFLECTION?

Yael Nurick, Abraham Arcavi, Ronnie Karsenty

Weizmann Institute of Science, Dept. of Science Teaching, Israel

The scientific literature acknowledges the significance and benefits of reflection to teachers' practice and offers a variety of tools and environments for reflection-based professional development. In this paper, we analyze mathematics teachers' reflection in three different settings, using six categories of reflection we previously developed. We examine the unique opportunities for reflection that each setting offers and how it may cater for teachers' different needs.

INTRODUCTION AND THEORETICAL BACKGROUND

Reflection can be characterized as a process of looking at past, present, and future experiences in a detailed, analytical, and careful way, while considering plans, intensions, and behaviours, in order to gain insights about the self, about decisions and about actions (Karsenty & Arcavi, 2017). Reflection is a key component of professional development of mathematics teachers (Brown & Coles, 2012; Karsenty & Arcavi, 2017), since it can enhance awareness to teaching practices and to their underlying beliefs, thus enabling decision-making to become more deliberate (Finlay, 2008; Karsenty & Arcavi, 2017). Reflection may become a mechanism of knowledge development as well as a trigger for processes of change (e.g., Karsenty et al., 2015; Karsenty & Arcavi, 2017; Schwarts & Karsenty, 2020).

Despite the potential benefits of reflection, several studies indicate that teachers struggle to conduct productive reflective process, and may even be reluctant to engage in it altogether (Finlay, 2008; Korthagen, 2014; Lyons, 2010). Several explanations for this are suggested: First, definitions and models of reflection may be seen as somewhat abstract and unclear (Brown & Coles, 2012; Finlay, 2008; Lyons, 2010). Second, the importance of reflection and its potential value are not always fully recognized and appreciated (Finlay, 2008; Lyons, 2010). Third, reflection may sometimes be perceived as criticism, and as such can incite negative emotional reactions (Finlay, 2008; Korthagen, 2014). Finally, reflective processes require time, resources, and support, which are not always available within the intensive environment of the teaching profession (Finlay, 2008; Korthagen, 2014). However, the literature indicates that given careful guidance and appropriate tools, reflection can be productively learned and enacted (Finlay, 2008; Lyons, 2010).

This study aims to contribute to the existing knowledge on reflection, and how it can be supported. The focal point of the study is probing mathematics teachers' reflections as they are carried out in "real life", in three different settings, each with its inherent features. These settings are: (1) a professional development course (described below); (2) weekly reflective journals; and (3) stimulated-recall interviews where teachers

watch their own videotaped lessons. In our analysis, we sought to characterize the reflections conducted by teachers in these different settings, in order to learn about the opportunities for reflection provided to teachers in each such setting. The ensuing research questions was: *What opportunities for reflection do different settings provide to mathematics teachers?*

THEORETICAL FRAMEWORK

In a previous work (Nurick et al., accepted), we unpacked the concept of reflection into six main categories (see Table 1), based on the existing literature, as well as on our own inductive analysis. These categories relate to actions that mathematics teachers perform when they reflect on their teaching practices.

Category (action)	description
Analysis of a situation	Analyzing and examining reasons for what happened; considering goals that stand at the basis of decisions and actions; cogitating broad aspects, issues, and contexts; evaluating the situation and the teacher's actions
Consideration of alternatives, doubts, or dilemmas	Pondering alternative actions, practices or perspectives and their possible applications; deliberating on certain issues; referring to dilemmas of practice
Re-orientation	Arriving at new insights as a result of the analysis, as realized either in "thinking forward", i.e., referring to possible future actions, or in a change in the teacher's perspective (e.g., beliefs or perceptions)
Consideration of beliefs	Considering, reviewing, or questioning beliefs regarding mathematics, mathematics teaching and teachers' roles
Addressing emotions	Confronting feelings emerging in certain situations
Addressing challenges of teaching	Elaborating various challenges that arise during teaching and analyzing them

Table 1: Categories of reflection (Nurick et al., accepted).

METHODOLOGY

Data collection

The study is defined as a collective case study (Yin, 2009) and comprises 11 cases of secondary school mathematics teachers. For each of the teachers, data was collected from three settings designed for stimulating teachers' reflection on the mathematics teaching practice:

VIDEO-LM professional development (PD) meetings: Each of the 11 teachers participated in one of seven PD courses offered in Israel in 2015-2016 by a large project

named VIDEO-LM (Viewing, Investigating and Discussing Environments of Learning Mathematics). The project aims at enhancing reflection skills and mathematical knowledge for teaching. Courses consist of 30 hours, divided into 7-10 sessions. In each session teachers watch a videotaped mathematics lesson taught by a different, usually unknown, teacher. The lesson serves as a basis for a peer discussion, directed and guided by a facilitator, who relies on a "six-lens framework" to observe and reflect on the mathematics, the lesson goals, the tasks, the classroom interactions, the teacher's dilemmas, and his/her manifested beliefs (for details, see Karsenty & Arcavi, 2017). For the purpose of the study, sessions in all seven courses were videotaped, and all excerpts in which the 11 teachers (the study subjects) talked were transcribed.

Weekly Reflective Journals (RJ): The 11 teachers wrote personal journals on a weekly basis during five months. In these journals, the teachers were asked to write about the most significant event which happened to them during the week, either while preparing for class or during the teaching itself. They were requested to relate to the reason the event was significant for them. There was no additional guidance or instructions.

Stimulated-Recall Interviews (SRIs), based on a videotaped lesson: One lesson (of the teacher's choice) was filmed for each of the teachers. After some time, individual interviews were held with each teacher, where s/he watched the videotaped lesson with first author. The interviews were unstructured, and the only instruction for the teachers was that they are invited to stop the video whenever they see a "matter of interest" which they want to talk about. All the interviews were videotaped and transcribed.

Data analysis

The goal of the analysis was to identify opportunities for reflection that each setting offers to mathematics teachers. The analysis was done in several phases, while looking both across the 11 cases studies and across the three settings:

(1) <u>Defining units of analysis</u>: Expressions of teachers were divided into segments, with a different definition of "segment" for each setting: in the PD it was a turn or a sequence of turns where the teacher talked; in the RJ we took each weekly journal as one segment; in the SRI it was a sequence of turns where the teacher stopped the video and talked about a specific subject.

(2) <u>Coding</u> of the segments according to the six categories of reflection (see Table 1): Each segment was analyzed to identify which categories of reflection it alludes to.

(3) <u>Identifying patterns</u>: For each teacher we characterized the reflective process, relying on the coding as well as on repeated reading of the data.

(4) <u>Identifying opportunities for reflection</u> in each of the three settings: For each setting, searching for recurring patterns across the different cases helped us to point out the opportunities for reflection it may offer.

RESULTS

In this report we focus on opportunities for reflection identified in each of the settings. Due to space limitations, we present only some of the opportunities found, and demonstrate them using the case of Sam. At the time of the study, Sam had five years of experience. He taught in an urban junior-high school in a low socio-economic area.

Setting #1: VIDEO-LM PD – exposure to teaching practices and teachers' ideas as a catalyst for reflection

15 segments where Sam talked in the VIDEO-LM PD were analyzed. In 12 of the segments, a similar pattern was identified: Sam noticed a situation in the videotaped lesson, or an issue raised by another teacher. This led Sam to a reflection where he offered an alternative action and analyzed it. To exemplify this pattern, we describe a section from the third PD meeting of the course, where the teachers watched an introductory lesson to the topic of "growth and decay problems".

At the beginning of the videotaped lesson, the teacher presented two questions: one relating to the increasing price of a painting and the other to the decreasing price of a used car. The PD participants ascribed the following possible goal to the filmed teacher's choice of questions: to emphasize that in both growth and decay problems there is always a factor by which one multiplies to obtain a sequence of values. When the teachers wondered if the presented questions are appropriate for this goal, Sam said:

Sam:	I think what Josh [another teacher in the PD] was trying to say, is that it would perhaps be better to present the same question. He [the filmed teacher] used a painting for the first question and a car for the second. [It's better to ask] the same question, let's say about money or a question of prices going up or down, but within the same context. […].
Facilitator:	You would have used something with money [or] something with bacteria […] Why? What does it enable?
Sam:	Because I think that here [in the lesson] they can… you can never know, but if you would have asked the students what is the difference between the questions, some might have not said that 'this is growth and this is decay', but that 'here it's a painting and here it's a car'.
Facilitator:	But as Aaron [another teacher in the PD] says, the context here has strength, because a painting of a famous artist, you expect, especially if you present it like that, that its value will increase. A car, you would expect that…
Sam:	Okay, as a later stage I would of course present questions from different contexts, to demonstrate it's the same. But at first I think I would show the same context. Then, maybe yes, expose them to a variety of questions,

Sam's articulations in this segment are representative of how he often demonstrated the following reflective actions: he referred to a situation that he identified, either in the videotaped lesson or in contributions made by another teacher in the PD, and *offered an alternative action*; he *analyzed the situation*, while explaining his goals and

considerations (e.g., presenting the concept of a growth factor while avoiding surplus "noise"); he *referred to students' possible mistakes*, attending to assumptions on what is easy or difficult for them. In other segments he also related to *students' emotional challenges*. In addition, the last utterance was categorized as *re-orientation*, since after the facilitator' comment about the potential strength of the context, Sam expressed a certain shift in his perspective. However, the re-orientation category was not common in other segments. Sam usually did not refer to his *beliefs*. In the PD, he tended to present successful events and practices from his classroom, using a decisive tone to present his ideas, which hints to the need to save face. Nevertheless, comments made by the facilitator or by other teachers led Sam to rephrase and clarify his stance.

Setting #2: Reflective journals – a personal arena for a focused and deep analysis

Sam wrote 15 weekly reflective journals. Here too, he usually related to positive events, however unlike in the PD he also elaborated his beliefs and goals while revealing challenges and dilemmas he faced. Sam wrote relatively long journals (220 words per journal, on average). His writing was fluent, and it seemed he devoted time and thought to it.

Of the 15 journals Sam wrote, 12 related to situations in lower-level classes he taught. He often began with *addressing general mathematical-pedagogical challenges* (e.g. "Once again, I realized how difficult it is for struggling students to deeply understand the meaning of mathematical rules, concepts and definitions", RJ#6), or with alluding to specific student mistakes (e.g., "I gave the students a task, to collect like terms in the expression $13m + b + m + 4 + 1 + 3b − 3m$ […] a common solution was $17m + 4b + 5$", RJ#3). Sam *analyzed the situations* in a detailed way: he evaluated his actions and considered his goals, while referring to different aspects, especially to affective aspects of students learning (e.g., "students with low self-image in mathematics get frustrated easily, every little change takes them out of balance", RJ#6). Sometimes, Sam included a mathematical analysis, for example when he analyzed the different roles of arithmetic symbols, or when he wrote on the nature of mathematics as a discipline. Sam also *considered his beliefs* toward teaching mathematics to struggling students, and how he views their characteristics and the ensuing teacher's role (e.g., "giving students such challenges can change their attitudes towards the subject and can also develop their confidence to cope with unfamiliar exercises", RJ#4).

Unlike his articulations in the PD meetings, in his journals Sam hardly *considered alternative actions*. When he did so, it was usually as a contrast to a preferred action he already took. For example, in his first journal Sam wrote: "formulas should not be taught in a technical way, we should explain the rationale behind them, even to struggling students". On some occasions, Sam *expressed intense emotions* (e.g., "I felt that as a teacher, I sometimes lapse in teaching these concepts briefly, skipping quickly to the next topic", RJ#6). Regarding the *re-orientation* category, in some journals a change in Sam's perception could be identified, sometimes through his choice of words (e.g., "I learned"), or when he noted he was impressed with a new method that he tried

in his class for the first time. Overall, Sam tended to write in a manner that can be interpreted as decisive and self-assured.

Setting #3: SRIs – a unique opportunity for in-depth self-observation

The SRI enabled Sam to talk at length about concrete situations he identified in his videotaped lesson, while analyzing them and connecting them to his goals and beliefs. Sam's SRI was focused, at his request, on the first part of a lesson in an advanced level 8th grade class. The subject of the lesson was the meaning of intersection points of linear graphs, by means of a realistic problem Sam posed. Students were asked to compare two optional destinations for vacation, Thailand and London, each with fixed expenses (e.g., air fare) and expenses depending on the length of stay (e.g., hotel, food). Based on different representations of the problem (tables, graphs, etc.), the class discussed various questions such as what is the meaning of one graph being higher than the other in different domains; what is the meaning of the intersection point of the graphs; where should one fly, based on how many days of vacation can be taken, etc.

The SRI was divided into 14 segments. Sam usually began with *analysis of the situations* he identified in the lesson: He considered the goals of his actions ("This is an important point […] I want the students to be accurate") and evaluated consequences of his actions ("in the first task, I gave the students some anchor, and then in the second task they immediately knew what to do"). He also *considered his beliefs* in detail. Sam's *consideration of broad aspects* was salient in the SRI. He related to both mathematical-pedagogical and interpersonal aspects ("the subject of linear functions is considered to be not easy, but when it is well-structured then it is interesting and relevant"). He also mentioned ways the socio-economical background of his students influences his decisions, for example to deliberately use high register words, in order to enrich students that he knows are not exposed to such words in their homes. However, in the SRI Sam hardly analyzed the mathematical content. Interestingly, unlike in the other settings, in the SRI Sam *addressed emotions the situations evoke* in him, both positive emotions of satisfaction and less pleasant emotions, for instance:

> Often, we teachers […] provide the answer ourselves […] and this is in my view my biggest problem. It is hard for me [to wait for students' answers] for two reasons. I want to cover the content, but also, I am afraid to let them… Maybe I don't trust them enough.

Regarding the categories of *considering alternative actions* and *re-orientation*, different and sometimes opposing patterns were identified within Sam's articulations in the SRI. Sam related to mathematical-pedagogical actions and choices in a confident way, defending them against other alternatives, but when relating to generic issues of teaching, he was less confident and sincerely considered alternatives. Searching for evidence for *re-orientation*, it was hard on the one hand to identify changes in Sam's perceptions or to trace thoughts about different future actions. On the other hand, the SRI revealed instances in which Sam seemed surprised by students' answers and behaviors which he missed noticing while he was teaching, and his reaction conveyed a shift in his view. For example: "wow, this student, I'm shocked […] I suddenly look

at him in a completely different way, he has a learning disability […] and his answers are great". Overall, Sam's talk in the SRI was not always coherent or linked to situations in the video. Although we identified various categories of reflection, we also characterized Sam's articulations as sometimes tending to take the form of explanations and even self-justifications, at the expense of learning-oriented analysis.

CONCLUSIONS AND DISCUSSION

In this paper, we analyzed reflections of a mathematics teacher on his practice in three different settings. Sam's example is representative of what we learned about the three settings and the different opportunities for reflection they offer, as we elaborate below.

In the PD meetings, participants observed and discussed teaching practices enacted in videotaped lessons, a setting which enabled them to listen and consider ideas and comments of each other. This exposure stimulated and promoted teachers' reflection, based on the co-analysis of alternative practices, goals, actions, and more. In line with previous work (Karsenty & Arcavi, 2017; Karsenty et al., 2015; Schwarts & Karsenty, 2020), we suggest that a video-based PD setting offers a combination of peer discussions, a vivid object for analysis (the videotaped lesson), and guidance provided by a facilitator, which allows for deep reflection. Nonetheless, PD meetings do not always allow for personal reflections to arise. Issues such as the need to save face and the balance of power relations in the group can inhibit some teachers' reflection.

Journal writing offers teachers an intimate arena for a focused and deep personal analysis, where they can candidly write about specific and focused situations. In line with previous findings (e.g., Hiemstra, 2001), we found that the affordances of a journal include the possibility to freely express challenges, beliefs, and emotions and to inspect oneself critically, something that may be harder to do in the social environment of a PD. However, journal writing lacks external stimulus, guidance, and peer interaction, and thus some teachers will not fully utilize its benefits.

The SRI also provides a personal setting, where teachers can watch an authentic representation of their own teaching, examine situations, analyze, and evaluate them. The detailed depiction of one's own actions as displayed in a video, helps teachers to notice situations, including those that were overlooked in "real time". Nonetheless, self-watching stirs emotions, and some teachers tend to criticize themselves, or alternatively justify their actions, instead of productively examining their practice.

The results of this study reveal that beyond the importance of any reflection process per se, the settings in which the reflection takes place and their specific affordances (or limitations) make a difference. Thus, attempting to support teachers in learning to reflect, either by providing guidance or by offering various tools (Finlay, 2008; Lyons, 2010), must consider not only the inherent complexities of the processes, but also the possible different contexts in which to enact them. Rather than implying that there is a preferred setting, we point to the need to consider the characteristics of each of the three settings, and how they (and possibly others) may complement each other.

Acknowledgment

References

Brown, L., & Coles, A. (2012). Developing "deliberate analysis" for learning mathematics and for mathematics teacher education: how the enactive approach to cognition frames reflection. *Educational Studies in Mathematics*, *80*(1), 217–231.

Finlay, L. (2008). Reflecting on 'Reflective practice'. *Practice-based Professional Learning*, paper 52, 1–27. The Open University. http://www.open.ac.uk/opencetl/resources/pbpl-resources/finlay-l-2008-reflecting-reflective-practice-pbpl-paper-52.

Hiemstra, R. (2001). Uses and benefits of journal writing. *New Directions for Adult and Continuing Education*, 90, 19–26.

Karsenty, R., & Arcavi, A. (2017). Mathematics, lenses and videotapes: A framework and a language for developing reflective practices of teaching. *Journal of Mathematics Teacher Education*, *20*(5), 433–455.

Karsenty, R., Arcavi, A., & Nurick, Y. (2015). Video-based peer discussions as sources for knowledge growth of secondary teachers. In K. Krainer & N. Vondrová (Eds.), *Proceedings of the 9th congress of the European Society for Research in Mathematics Education* (pp. 2825–2832). ERME.

Korthagen, F. A. J. (2014). Promoting core reflection in teacher education: Deepening professional growth. In: L. Orland-Barak & C. J. Craig (Eds.), *International teacher education: Promising pedagogies (Part A)* (pp. 73–89). Emerald.

Lyons, N. (2010). Reflection and reflective inquiry: Critical issues, evolving conceptualizations, contemporary claims and future possibilities. In N. Lyons (Ed.). *Handbook of reflection and reflective inquiry: Mapping a way of knowing for professional reflective inquiry* (pp. 3–22). Springer Science & Business Media.

Nurick, Y., Arcavi, A., & Karsenty, R. (accepted). Revisiting the concept of reflection: An empirical investigation of mathematics teachers' articulations on the teaching practice. Paper accepted for presentation in the 12th congress of the European Society for Research in Mathematics Education, February 2022.

Schwarts, G., & Karsenty, R. (2020). "Can this happen only in Japan?": Mathematics teachers reflect on a videotaped lesson in a cross-cultural context. *Journal of Mathematics Teacher Education*, *23*, 527–554.

Yin, R. K. (2009). *Case study research* (4th ed.). Thousand Oaks.