

# They saw and dared to call things mathematics: facilitators' views on an online mathematical professional development module

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*Although much money is expended on developing professional development resources, little is known about how facilitators, who often mediate the materials for teachers, evaluate them and how these evaluations compare with those of the teachers. To provide input into this area, the results from a survey completed by 59 facilitators of an online mathematics module for preschool teachers are described and compared with those of preschool teachers. Although the facilitators gave similar responses about the three design elements of the module—content, tasks and relationships—they also noted needs, which were not covered by what was in the module itself.*

## **Introduction**

In this paper, we analyse the results of a survey answered by 59 facilitators about their experiences with online modules for preschool teachers' professional development (PD) to provide insights into the design of these materials. We compare the facilitator results with those of teachers who undertook the course. Identifying differences as well as similarities in views provides insights into whether the facilitators' understandings of the materials are shared by the teachers and if the materials should be altered to increase the impact on teachers' learning.

Recently, preschool teacher PD has received attention with a special issue on this topic being published in 2017 in *Mathematics Teacher Education and Development*. Most of these articles have focused on changes to teacher practices or knowledge. Of the few papers on facilitators of PD for preschool, the focus is on the training of the facilitators (Hassidov & Ilany, 2014). Nevertheless, calls have been made to focus more on the important role of facilitators in PD in mathematics teacher education (Lange & Meaney, 2013). This is particularly necessary when facilitators mediate online PD materials developed by others as “little is known about best practices for the design and implementation of these oTPD (online teacher professional development) models” (Dede, Ketelhut, Whitehouse, Breit, & McCloskey, 2009, p. 9). Hill, Beisiegel, and Jacob (2013) called for an evaluation of PD design elements from a range of teachers and facilitators to build up a body of knowledge that moves beyond local, idiosyncratic

approaches to implementation. As online PD is likely to be utilised more often in the future (Dede et al., 2009), there is a need to understand from users, such as facilitators and teachers, what are the design features that effectively support PD.

## **Background**

In 2012, Sweden initiated a large-scale PD programme for mathematics teachers. Administered by the Swedish Agency for Education (Skolverket), teachers in collegial groups read, discuss, plan and try activities and reflect on their experiences. The input for these tasks comes from web-based PD modules, which for preschool teachers have 12 parts to be completed over 18 months. All modules have the same structure with each part comprising four sections: (A) individual studies; (B) group discussion and planning; (C) enactment/observations in own teaching situations; and (D) group discussion and follow-up.

In previous research (Helenius, Johansson, Lange, Meaney, Riesbeck, & Wernberg, 2015), we described a design model for PD materials based on our decision-making during the production of the first third of the PD-module materials. The design model includes 3 elements: content deemed as important for teachers to understand; tasks for the teachers to undertake; and the relationships that needed to be nurtured. We consider that the choice of content is the driver of the other two elements. For the preschool module, the content was based on Bishop's (1988) six mathematical activities, because curricula and policy documents indicated that this was the knowledge teachers needed (Skolverket, 2011; Utbildningsdepartementet, 2010).

The 12 parts of the preschool module that provide input on the content are: (1) Introduction to Bishop's (1988) six mathematical activities; (2) Playing; (3) Explaining; (4) Documenting what the child can do; (5) Introduction to Locating and Designing; (6) Locating; (7) Designing; (8) Documenting for teacher planning; (9) Introducing quantifying; (10) Measuring; (11) Counting; and (12) Documenting for supporting the work environment. Each set of four parts had an introduction, two parts related to Bishop's six mathematical activities and a summary part which discussed different aspects of documentation.

Although Skolverket financed facilitators for school teachers, similar funding was not made available for preschool teachers. The teachers were instead expected to organise themselves into groups, which would then work through the online materials. However, when the materials were made available online, many municipalities funded facilitators to organise PD sessions for groups of preschool teachers to support their involvement. However, at this point in time, there was no training specifically for these facilitators.

We collected data through an online survey for teachers and one for facilitators, from March to May 2016. The surveys included similar questions, modified to suit the different roles of teachers and facilitators. Contact was made

with municipalities, across Sweden, where it was known that their preschool teachers had completed at least 4 out of the 12 parts of the module (the equivalent of at least 6 months' worth of work). The municipalities then forwarded the link for the online survey to teachers and facilitators.

Both surveys had 27 questions, 21 were multiple-choice and the other six were open-ended. Both surveys asked for information about the mathematics that participants had in their teacher education and their years of experience working in preschools. The open-ended questions provided comments from the facilitators about the three elements of the design model; content, tasks and relationships.

## **Results and Discussion**

In this section, the results from the facilitators are compared with the results from 267 preschool teachers, published in Helenius, Johansson, Lange, Meaney, and Wernberg (2017). We do this to gain insights into whether the facilitators' understandings of the materials were the same as the teachers and if the materials could or should be altered to increase the impact on teachers' learning.

The facilitators and the teachers (Helenius et al., 2017) had similar amounts of mathematics in their teacher education, similar amount of experience of working in preschools, and had completed similar amounts of the online module. Of the 59 facilitators, 8 (14%) had less than five years' experience working in preschools, 8 (14%) had between five and ten years and 43 (73%) had more than ten years. 29 (49%) of the facilitators had no mathematics in their teacher education, 27 (46%) had 15 ECTS and 2 (3%) had 30 or more ECTS; one did not respond to the question. 50 (85%) of the facilitators had completed eight or more parts of the module and the rest at least four parts. A similar proportion of teachers had finished at least four parts, but 12% had completed all twelve parts. In the next sections, we describe the results for the three elements: content, tasks and relationships.

### **Content**

The facilitators provided information on content by answering questions about which parts of the module they appreciated the most and the least. The questions allowed for more than one part to be nominated. As was the case for the teachers, far fewer facilitators indicated a part of the module that they appreciated the least than a part that they appreciated the most.

The parts that were nominated by more than 20% of the facilitators as being appreciated the most, were: (2) Playing, (6) Locating, and (7) Designing, which was nominated by 30%. These results are similar to those of the teachers (Helenius et al., 2017) and indicated that the parts appreciated the most included content specifically about Bishop's (1988) six mathematical activities.

The parts that the facilitators liked the least were (5) Introduction to Locating and Designing, (6) Locating, and (8) Documenting for teacher planning, which were nominated by 14% of facilitators. Although these results differ from those of

the teachers (Helenius et al., 2017), the numbers are too small to indicate a clear trend.

Locating featured in both the most and least appreciated part, which was also the case for the teachers (Helenius et al., 2017). This suggests that more information is needed about why Locating produced such divided views. In the open-ended question, one facilitator (F48) explained why they liked Locating the most, “jag uppskattade mest "lokalisera", det satte igång både lärarens och barnens fantasi” (I appreciated "Locating" the most, it initiated both the teacher's and the children's imagination”). However, there were no comments about why it was liked the least, indicating that further research is needed on this.

It could be that the facilitators needed more time to better understand the ideas to do with Locating. Like some teachers (Helenius et al., 2017), several facilitators indicated that it was only after completing several parts that they could understand how the parts were related. For example, F15 wrote “det har varit trögt innan begreppen lagt sig och fått förståelse för arbetslaget. pga att det går fort fram blir det rörigt varje gång en ny [del] inleds”. (It has been slow before the concepts have settled and gained understanding in the work team. Because it progresses quickly, it gets messy every time a new [part] is started).

Other comments, similar to F15, suggest that the facilitators found the content to be challenging for the teachers in that it extended their combined understandings about what children could do mathematically in preschools. F37's response to the question about which part they appreciated the most illustrates this point:

F37:           Väldigt svårt att välja en! Spontant så skulle jag säga att delen om leka och förklara är det som gett oss mest. Detta med tanke på att man ofta inte tänker de delar som matematik”  
Very difficult to choose one! Spontaneously, I would say that the part about playing and explaining is what has given us the most. This is because you often do not think of these parts as mathematics.

Other facilitators talked about witnessing “aha experiences”, suggesting that while the content may have been challenging, it provided opportunities for the teachers (and the facilitators) to gain new insights. Many also indicated that the teachers were, more than earlier, able to see mathematical learning opportunities in their work and more willing to discuss mathematics together. The results in Table 1 showed the responses the facilitators gave to the questions about why a part was appreciated the most or the least.

More facilitators indicated that it was the tasks, including the discussions, rather than what the teachers learnt that made them appreciate a part (this is discussed in more detail in the next section). Half of the facilitators indicated that they chose a part as being least appreciated if they considered the written texts and films in sections A and B to be difficult to understand. This is perhaps not

surprising as these were the vehicles for transmitting the content. In a response to the open-ended question about this, F30 wrote, “Tycker att alla moduler varit bra, med en del texter med svåra ord att bena ut kanske uppskattades minst” ([I] think all parts have been good, with some texts with difficult words to work out maybe being appreciated the least).

	The teachers learnt the most /least from it	The written texts and films made it easier/harder to understand the message	The activities with children clearly showed/did not show how much mathematics they can do	The discussions with colleagues facilitated (not) understanding of the message in the part
Most (n=53)	15 (28%)	12 (23%)	34 (64%)	28 (53%)
Least (n=44)	15 (34%)	23 (52%)	6 (14%)	8 (18%)

Table 1: The reasons for why a part was most or least liked by the facilitators (Q9 & 11)

### Tasks

The module tasks were situated in the four sections, A, B, C, D, in each of the 12 parts. As designers, we had to make the tasks specific and connect them to the context. To do this, we considered: How can the affordances of context and artefacts be utilised to support content delivery? Why would teachers want to engage in these activities? Therefore, we asked the facilitators about what supported or hindered the teachers’ learning in two survey questions where they could choose more than one answer. Tables 2 and 3 show their responses as well as the compatible teacher responses from Helenius et al. (2017).

	Materials	Discussion with colleagues	Trying out activities with children	Documentation of own and children’s learning
Facilitators (n=59)	18 (30%)	51 (86%)	47 (80%)	26 (44%)
Teachers (n=255)	53 (21%)	201 (79%)	141 (55%)	76 (30%)

Table 2: The tasks that the facilitators considered to contribute the most to teachers’ learning.

	Time to do PD	Texts too hard	Film not relevant	Activities too difficult to implement	Activities not appropriate for children’s group	Discussions not helping learning
Facilitators (n=56)	47 (84%)	30 (54%)	20 (36%)	8 (14%)	17 (30%)	2 (4%)
Teachers (n=245)	204 (83%)	105 (43%)	73 (30%)	51 (21%)	52 (21%)	3 (1%)

Table 3: The difficulties for teachers learning from the PD tasks

The facilitators and the teachers valued the tasks to a similar degree (see Table 2). Although the facilitators appeared to be generally more positive, the differences were not statistically significant using a chi-square test. The facilitators considered

that discussions with colleagues and trying out tasks with children contributed the most to the teachers' possibilities to learn.

In contrast, Table 3 shows that a lack of time was considered the biggest hindrance to teachers' possibilities to learn by the facilitators and the teachers (Helenius et al., 2017). However, as F13 noted, facilitators acknowledge that a lack of time was often compounded with other issues outside the scope of the module:

För att kunna förändra den rådande praktiken måste man förstå. För att kunna och vilja förstå behöver man vara intresserad. Fokuserar man på annat t.ex. tidsbrist stänger man in sig i ett hörn, tyvärr. Olika utbildningsnivå har påverkat väldigt mycket.

In order to change the current practice, one must understand. To be able and willing to understand, you need to be interested. Focusing on other things e.g. lack of time, pushes one into a corner, unfortunately. Different levels of education have had a great impact.

Of the tasks which the module indicated that the teachers were expected to engage with, the facilitators, as had the teachers, highlighted the impact of texts, which were too hard to read, on teachers' possibilities for learning. Facilitators would have been expected to support the teachers to understand the text, but with similar education and background to the teachers, they may have struggled with the texts in the same way. As designers of the module, it is important to consider how to provide texts that better support teachers to engage with the content. Support materials written specifically for facilitators, which might have helped them to support the teachers' academic reading were made available at a later date.

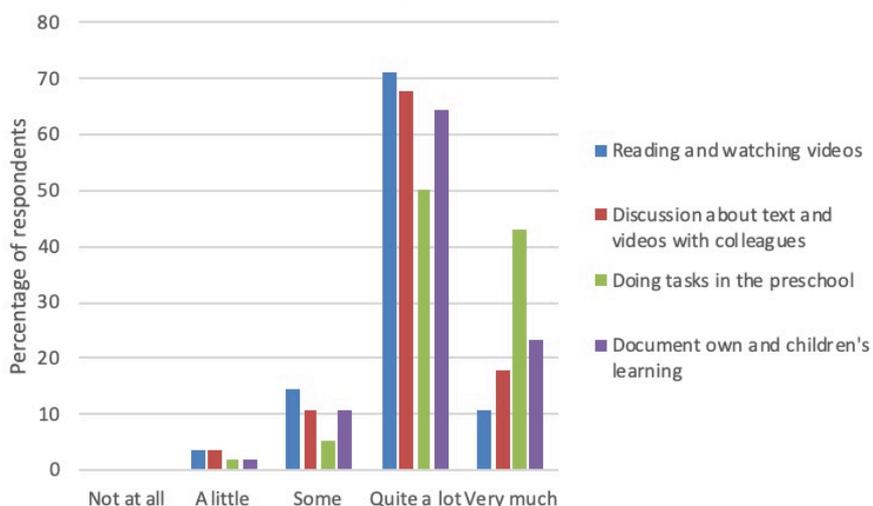


Figure 1: Graph of contribution to learning by percentage of facilitators

Figure 1 shows that more than 80% of facilitators considered that all the tasks contributed “quite a lot” or “very much” to the teachers' learning. This included reading texts and watching the videos, which teachers had also nominated to the

same degree in their responses to their question on this (Helenius et al., 2017). Some of the facilitators suggested that the concepts in the texts and the films became understandable when they were discussed with the teachers. For example, F46 stated, “Genom att de diskuterade texterna och filmerna med varandra och försökte hjälpas åt med vissa begrepp som kunde ibland uppfattas vara svåra att begripa” (By discussing the texts and films with each other and trying to help each other with certain concepts that could sometimes be perceived as difficult to understand). When the teachers engaged with the concepts, the facilitators noted that they learnt. F21 summarised the impact of the PD tasks on the teachers’ learning by stating “De såg och vågade att kalla saker för matematik” (They saw and dared to call things mathematics).

In some responses to the open-ended questions, documentation – when completed – was highlighted as a valuable tool for supporting conversations. For example, F35 stated, “Dokumentationerna gör att vi kunde få syn på sådant som vi inte sett under själva aktiviteten samt kunna diskutera hur vi går vidare” (The documentation means that we could see things that we did not see during the activity itself and are able to discuss how we are going to proceed). However, some comments suggested that the documentation was not completed or only connected to being able to see mathematics everywhere (see Helenius et al., 2017). Not completing the documentation activities could affect teachers’ relationships with each other, the facilitators and parents, as discussed in the next section.

### Relationships

In designing the module, we recognised that there were a number of relationships that needed to be supported through the materials. One of these was the relationship between us and the teachers. However, when there were facilitators, then they and not the materials mediated the content and tasks to the teachers, with our relationship to both groups taking on a different role.

Table 4 outlines what the facilitators considered to be the most important part of their role (they could give more than one answer). It is unclear whether the facilitators who nominated “ensuring the teachers had access to the materials” simply meant distributing the materials or making them understandable to the teachers. However, almost all the facilitators saw supporting discussions, presumably on the materials, as important.

	Ensure teachers have access to the material	Support discussions in sections B and D	Support the practical tasks in section C	Evaluate the documentation
Facilitators n=59	37 (63%)	51 (86%)	18 (31%)	23 (39%)

Table 4: The tasks that the facilitators considered to be most important

In discussing their role in the open-ended question, the facilitators acknowledged that it was sometimes hard to get teachers to engage in the different tasks. For example, F38 wrote “försökte men svårt då jag har kollegor som inte tycker att detta varit så roligt” (tried but hard when I have colleagues who do not think this

was so fun). In this case it seemed that the online materials were not in themselves sufficient stimulus for the teachers to engage with the PD. In contrast, other facilitators mentioned that the materials seemed to exert pressure on the teachers to engage in the tasks. For example, F18 stated, “Man ’tvingas’ in i uppgifter - bra att få lite press på sig så att det blir gjort. De har ändå sett vad mycket matematik det finns och går att få in i verksamheten” (One is "forced" into tasks - good to have some pressure put on you so that it gets done. They have nevertheless seen how much mathematics there is and that can get into the work situation). When the teachers did engage with the materials, the facilitators considered they learnt more.

As the designers of the PD materials, we had tried to engage the teachers by ensuring that the materials made use of the teachers’ previous experiences. 41 out of 56 facilitators (73%) considered that the materials did this quite a lot or very much. However, the facilitators noted difficulties with comprehending the texts, which could be considered as occasions where we, as the designers, had misunderstood the teachers’ competencies. To overcome these difficulties, the facilitators often mentioned the role of discussions.

F37: Att få höra vad andra fastnat för i texten, både det som är lätt och svårt har gett en ökad förståelse för textens innehåll. Att få förklara det man kan för någon annan ger en större förståelse. Kollegialt lärande är toppen, tillsammans är vi starka!

Being able to hear what others got stuck with in the text, both what is easy and difficult, has given an increased understanding of the content of the text. Explaining what you can [i.e. understand] to someone else gives you a bigger understanding. Peer learning is the top, together we are strong!

As the designers of the module, we had wanted the materials and tasks to support the teachers to develop their relationships with children, colleagues and parents. Figure 2 suggests that the facilitators indicated that this was the case, although the impact was the most with children and the least with parents. Similar results arose from the teacher survey (Helenius et al., 2017).

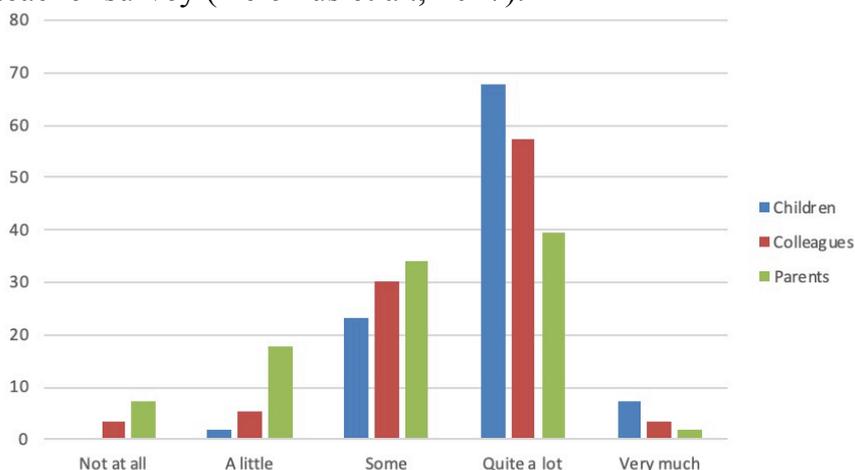


Figure 2: Facilitator views on how the module affected teachers’ relationships

Many of the facilitators commented about how teachers' relationships with children could be extended by challenging the children mathematically, "Att lärarna tar tillfällen i akt att lyfta barnens matematiska kunnande, mycket mer spontant än tidigare" (The teachers take the opportunity to raise the children's mathematical knowledge much more spontaneously than before) (F56). For this facilitator, the materials provided support for teachers to identify mathematical learning opportunities for the children, which may have gone unnoticed earlier.

It may be that teachers saw increasing their relationships with children as their main role, but had difficulty considering how mathematics education could increase their relationship with parents. Therefore, there was a potential role for facilitators to emphasise the possibilities for this in the materials that might have been missed by teachers who were focused on what they considered to be their main roles. Nevertheless, some facilitators noticed that working with the module did provide teachers with new ways to engage parents in discussions about their children's mathematics. For example, F20 stated, "Vi har blivit bättre på att tala om för föräldrarna hur och varför vi arbetat med matematiken i vår vardag" (We have become better at telling parents how and why we worked with the mathematics in our everyday). Some facilitators noted that documentation tasks in the module supported teachers to have materials that facilitated conversations with parents. However, other facilitators noted that it was not always easy to talk about the children's mathematics with their parents, especially when they had another mother tongue, "de har i princip annat hemspråk allihopa och har svårt att förstå" (They basically all have different home languages and have difficulties understanding) (F19). The materials did not provide suggestions for overcoming this problem.

## **Conclusion**

Hill et al. (2013) challenged the PD community to gather evidence from a range of different contexts to consider how design elements operate in different local situations. The Swedish PD programme for preschool teachers provides one such context. Comparing the results from the facilitators with those of the teachers (Helenius et al., 2017) indicates that there were many similarities in the responses. In regard to the content, the facilitators like the teachers considered that the content gave the teachers new insights into mathematics education in preschool. However, sometimes time was needed for the teachers to understand how to connect the new ideas to what their experiences in preschools and it was the facilitators who had to keep the teachers motivated while they made these adjustments to their thinking.

In regard to the tasks, the facilitators noted that discussions with colleagues was very useful in supporting the teachers to make sense of their readings. Doing things with children also resulted in the teachers experiencing "aha-moments". Although the reading of the texts was seen as an important part for gaining these

moments, there is some research to be done on how to support the facilitators to do. In particular, more needs to be known about how facilitators mediate the materials as well as how we as the designers can rewrite some of the texts to make them more easily understood but ensure they remain challenging. This could ease the work of the facilitator in motivating the teachers to persevere in reading and making sense of the texts. According to the facilitators, doing activities with the children seemed to support teachers to elaborate on their relationships with children. To a lesser extent, the facilitators seemed to consider that the materials had supported the teachers to engage with parents about the mathematics education the children were doing. Again, research is needed to investigate how to improve the possibilities in the materials to better support relationships with parents but also to provide support to facilitators so they can better support what opportunities that were already there.

## References

- Bishop, A. J. (1988). *Mathematical enculturation: A cultural perspective on mathematics education*. Dordrecht: Kluwer.
- Dede, C., Ketelhut, D. J., Whitehouse, P., Breit, L., & McCloskey, E. M. (2009). A research agenda for online teacher professional development. *Journal of Teacher Education*, 60(1), 8–19. doi: 10.1177/0022487108327554.
- Hassidov, D., & Ilany, B. S. (2014). A unique program (“Senso-Math”) for teaching mathematics in preschool: Evaluating facilitator training. *Creative Education*, 05(11), 976-988. doi: 10.4236/ce.2014.511112.
- Helenius, O., Johansson, M. L., Lange, T., Meaney, T., Riesbeck, E., & Wernberg, A. (2015). Theorising the design of professional development web modules. In O. Helenius, A. Engström, T. Meaney, P. Nilsson, E. Norén, J. Sayers & M. Österholm (Eds). *Development of mathematics teaching: Design, scale, effects. Proceedings from Madif9: The Ninth Swedish Mathematics Education Research Seminar*, Umeå, February 4-5, 2014 (pp. 77–86). Linköping: SMDF.
- Helenius, O., Johansson, M. L., Lange, T., Meaney, T., & Wernberg, A. (2017). To gain knowledge of how to be challenging: Preschool mathematics professional development. *Mathematics Teacher Education and Development*, 19(3), 36–57.
- Hill, H. C., Beisiegel, M., & Jacob, R. (2013). Professional development research: Consensus, crossroads, and challenges. *Educational Researcher*, 42(9), 476-487. doi: 10.3102/0013189x13512674.
- Lange, T., & Meaney, T. (2013). Professional development facilitators: Reflecting on our practice. *Professional development in education*, 39(4), 531–549. doi: 10.1080/19415257.2013.796292.
- Skolverket. (2011). *Curriculum for the Preschool Lpfö 98: Revised 2010*. Stockholm: Skolverket.
- Utbildningsdepartementet. (2010). *Förskola i utveckling - bakgrund till ändringar i förskolans läroplan*. Stockholm: Regeringskansliet.