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TEACHER LEARNING THROUGH ORGANIZED EXPEREINCES

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This study investigates mathematics teacher learning in a professional development environment called Elementary Mathematics Laboratory (EML). In the EML, teachers observe and participate in discussions about a grade 5 mathematics class, and engage in a special kind of collective co-planning with the teacher of the class. The authors first understand the features of the settings by contrasting it with a regular professional development program. We elaborate the characteristics of teachers' participation within the features of each setting to understand role and impact of settings. Further we observe evolution of the participating teachers' questions, including what they notice and how they interpret significant features of the classroom interactions in EML setting for learning. Analysis for the study is based on data from one complete cycle of the program in which teachers met on consecutive days to watch and discuss the teaching they saw together, which involves their participation in the discussion before the class, to get a consensus on the plan for that day's class (pre-briefing), and after the class to discuss enactment (de-briefing). The change in the focus of questioning by the teachers was observed from day 1 to day 5, proving teachers' questioning to be a productive lens for investigating teacher learning. In summary we speak about the setting of EML and its features shaping teachers' participation and how teachers' questions evolve over the time in this specific setting.

Keywords: settings for professional development, teachers' learning, laboratory setting, teachers' participation features

INTRODUCTION

The use of videotapes for the study of teaching in professional development has become increasingly common. Although a range of design principles guide these varied programs, a key assumption shared by many of them is that watching teaching and reflecting on it is thought to be a valuable activity for teachers, one that has the potential to foster teacher learning (Sherin & Han 2004). Although watching live teaching is much less common, there are potential affordances of studying live teaching. Among these are: being able to focus one's viewing without having it pre-focused by the cameraperson; the authenticity of not knowing what is going to happen; participating in aspects of the actual design and development of the instruction itself.

The recent emphasis on practice-based professional development (Ball & Cohen, 1999) has made popular the use of artifacts of practice in professional development. Many studies use videos of teaching as a record of practice for their study. The claim is that teachers learn significantly from the reflection based on authentic representations of practice (Borko, 2004, Santagata, Zannoni, & Stigler, 2005). Elementary mathematic laboratory is an unique example of such setting, where teachers are engaged directly with practice, not only observing live teaching, but also co-planning the teaching with the teacher whose teaching they were observing. The process of co-planning happened in the pre-briefing and de-briefing sessions, organized around the teaching observation.

THE QUESTIONS AND THE STUDY

Considering the nature of the data, there were two sets of questions that we asked. The first set of questions was about the setting it self: What are the finer distinctions of settings that leverage teachers' participation? How can the kind of teachers' participation limit or extend teachers' learning to teach?; and the second set was about the teachers' questioning: What questions teachers ask while engaging in the practice-based activities? What do we learn from their questions about their participation, progress and involvement in the professional activity?

In this paper we report analysis of two of the research questions, each from the two sets, namely concerning features of the setting and teachers' questioning respectively. In the following paragraphs, first we describe the setting in which the professional development has happened, called Elementary mathematics laboratory (EML); then we situate the setting in contrast with the usual settings for professional development by taking an example of a professional development program around EML to see how EML facilitates teachers' participation; after this we briefly explain why teachers' questions were used as the measure for their participation and progress and finally we explain the observed evolution in teachers question across the 5 days of the program.

THE SETTING FOR TEACHERS' LEARNING

Often settings for teachers' learning are understood vaguely, and are referred as classroom practice, co-operative learning, learning communities, etc. We, in this paper refer setting as an organized design or a structure built for teacher learning. Any professional development setting with the purpose for teacher learning will be considered as a setting using our definition.

The EML setting

The EML is a two-week summer mathematics program at the University of Michigan School of Education. The laboratory is a special mathematics class for entering fifth-graders who

have been struggling with math in school. The mathematics class is collectively planned and studied by a diverse group of professionals, including teachers, researchers, teacher educators, student teachers, and mathematicians. The learning opportunities for teachers are organized in three events: (1) a pre-briefing; (2) class observation; and (3) a de-briefing.

Pre-briefing: The EML teacher (the teacher who taught 5th graders) presents the day's lesson plan, explains the goal and activities for the class, and raises any concerns she and other lesson-planners have about the lesson or particular students in the class. Observing teachers take active role in planning and suggesting changes in the planning from second day onwards of the program.

Class observation: During the two and a half hour instructional period, observers are seated either on risers in the back of the laboratory classroom or in an adjacent classroom where they can observe live video feeds from the class in a more relaxed setting that allows them to talk quietly among themselves.

De-briefing: After students leave the classroom at the conclusion of each lesson, the observers are invited to study the students' work in their notebooks and on the whiteboards. Everyone assembled analyzes the lesson they observed and makes preliminary suggestions for the next day. The discussion in the de-brief session is focused on various issues of teaching practice and led by the EML teacher.

Almost all these teachers joining the EML also take part in a professional development program, which happens at the same venue after EML. This professional development program is more typical compared to the EML and uses videos of teaching for reflection as a practice-based activity.

ANALYSIS

In this paper we present analyses of the teachers' discussions during the de-briefing sessions and the professional development session on videos of teaching. The analysis is based on the transcription during discussions. We use two aspects of teacher talk to learn about teachers' concerns and images of teaching practice: the questions they asked the EML teacher and the suggestions given for next days' teaching.

A. Contrasting EML and regular PD setting

To answer the first question, *what are the finer distinctions of settings that leverage teachers' participation*, we looked at how teachers participate in the discussion on teaching practice. To understand the nature of their participation in the EML de-brief session, we contrasted their talk with the talk in the professional development – reflection on teaching viewed through video activity.

Following table is a summary of our findings for the features of each setting and their impact on shaping teachers' participation in that setting. EML debriefing session refers to the session where teachers are directly speaking to the EML teacher after viewing the class and the EML

PD session refers, to more traditional video-reflection session in the professional development program happens around the EML.

Table 1: Characteristics of teachers' participation across settings

Characteristics of teachers' participation	EML debriefing session	EML PD session
Positioning	Co-planner	Participant learner
Purposes for participation	Understanding effectiveness of the teaching	Evaluating effectiveness of the teaching
Proposing improvements in teaching	Active: with actual enactment in mind	Passive: hypothetical, something worked in the past
Prompts for participation	Self generated (less organized)	Teacher educator generated (more organized)
Participation norms	Clarify teacher moves, suggest pedagogical inputs, share personal experience, etc.	Identify and evaluate teacher moves, share pedagogical experiments, etc.
Unit of practice analysed	Generally whole class with focus depending on individual's interest	Pre-decided by teacher educator – often small clip
Learning mathematical content	Demonstrative pedagogic content knowledge	In the form of traditional material
Material generation for further use	Informal: deciding pedagogies, finalizing math terminology for students, content unpacking, etc.	Formal: Common terminology to talk about teaching, generating a lesson sequence, etc.

Some of the characteristics were more direct and easy to understand given the nature of the two settings. For example – prompts for discussions, which were often self generated in the EML debriefing session as the nature of discussion was open and discussions were initiated by participant teachers, where as in the EML PD setting, teacher educator planned reflection prompts for the video and therefore the prompts were more structured and goal oriented. However some of the characteristics aren't that obvious.

Positioning:

Teachers positioned themselves differently in the two settings. There positioning was visible through the questions that they pose or the suggestions they provided.

> "Some students have problems with just visual representations, they need association with verbal explanation or at least with some terminology. So if we tell them to say how many equal parts every time they write fraction for shaded parts, will help them." (Tr. in EML-debrief)

The comment above was given when there was a discussion about students work on naming a fraction, where rectangle is divided into unequal parts. We see this comment as not just acknowledgment of the problem but support for what can be done based on self-teaching experiences. Similar to the comment above often we found that the teacher is positioning herself as a co-planner rather a participant learner.

> "Teacher never corrected students' errors and often asked other students as 'what do they think about those answers?' whenever a kid made error" (Tr. in EML-PD)

The comment above was given immediately after teacher educator opened the discussion with the prompt as – 'what do they all think about the class today?'. The remarks, in the PD session were given more from the learner point of view - where teacher positioned herself as a "participant learner" of teaching practice.

Purposes for participation:

When we looked at teachers' questions and comments, we also realized often the purpose of their talk is varies depending on the setting in which they are talking about the teaching practice. The teachers in the EML-debrief setting were concerned about finding out how effectively things worked in the actual teaching –

> "Why weren't students' wrong responses corrected? What if we tell students directly that those are not equal parts?" (Tr. in EML-debrief)

Whereas in the EML-PD session teachers were often evaluative about the teaching they saw.

> "The class was about three main tasks – the first one was separate from the rest two, the first task was writing fractions and other two were not connected with fractions. I have never seen any class, where you do things differently." (Tr. in EML-PD)

This agenda of teachers in PD sessions was more about evaluating the effectiveness of the teaching rather understanding the effectiveness**.**

Proposing improvements in teaching:

As teachers in de-brief looked themselves as the co-planners, the way they provided suggestions for the teaching were more concrete and situated in the practice. They provided suggestions as those could be used in the next day's teaching.

> "For teaching equivalent fractions, I tried the activity of superimposing cut-outs with my kids. You take transparent sheets and make fractions on them. Colour the parts as you will do on a normal paper. For example, 2/6 and 1/3, you make cut-outs for 2/6 by shading 2 parts out of 6 and … they understand why those fractions are equal" (Tr. in EML-de-brief)

The quote is very long and the details provided for the suggestion of teaching equivalent fractions are much finer, in contrast to the suggestions given in the PD sessions. Those were more general and hypothetical.

> "Working with manipulatives will help students to understand equal parts" or "I always used fractions area cut-outs and it worked" (Tr. in EML-PD)

In PD sessions teachers talk does not bear the responsibility of something will be tried the next day and therefore they tend to speak generally whereas in the purpose of de-brief is to look at the enacted class and suggest activities, tasks or topics for the next day. The suggestions given by teachers in the de-brief were from the co-planner perspective and hence more active and concrete, whereas the perspective of participant learner limited teachers to give any concrete suggestions and they tend to be more passive and hypothetical in what could work in the actual class.

Considering the length of the paper we won't able to discuss each of the characteristics of teachers' participation. However in summary, the roles that teachers take in each of the setting, is based on how they are perceived in the design of the setting itself. Our purpose here is not to understand which setting is better or worse than the other, but to understand how settings differentiate the participation and how does that impact teacher talk in those settings.

B. Studying evolution in teachers' questioning

The second component of the analysis that we plan to present in this paper is to see evolution in teachers' questioning from day 1 to day 5 of the program, within the EML – debrief setting.

Our analysis of teachers' questions to the EML teacher and things they notice from the teaching yielded three categories: (1) what to tell or not tell your students (often focused on perceived student errors and misconceptions), (2) material used and ways it might be adjusted or modified; and (3) student engagement. Interestingly the tone and the number of questions go down in consecutive days. Day 1 had the maximum number of questions, where as day 5 had the least number of questions. Following is a summary of teachers questions and a numerical evolution of those questions.

Table 2: Categories in teachers' questioning

Days in EML	On students' errors/misconception	Use of material and adjustment	Student engagement	Question Qualifier
Day1	16	5	10	Challenge
Day2	14	9	9	Challenge/ suggest
Day3	12	8	4	Suggest
Day4	10	8	0	Suggest/ reflect
Day5	10	5	0	Reflect

The three categories mentioned above are not exhaustive of the questions that teachers asked, but are the prominent one observed on day 1 and 2. During the later days teachers gave many comments, which were specific to students, as some of the teachers preferred to follow a one particular student's progress in those 5 days. What different teachers decided to follow in those 5 days turned out to be an important factor of the discussion during days 3, 4 and 5. For example some teachers focused on a particular student, and started discussing what that student said in the class, what is she writing in the textbook, what she might have thought, etc. Whereas some teachers followed use of textbooks by the EML teacher and discussed about how they use textbooks and how they found the use of textbooks here and how in future they plan to use the textbooks. In summary, the range of discussion and topics was wide because of the varied interested that individual teacher or groups of teachers were pursuing.

However, the three categories emerged on the day one and two remain significant as teachers' initial interaction with the teaching that they saw and with the EML teacher. A challenge was considered when we sense that the teachers thought that EML teacher could have done an alternative emphasis or the EML teacher could have stated clearly what is *correct way to do* some problems.

Example of each factor for challenge as mentioned earlier: in the class on day 1 there was a problem posed for students to name fraction for a shaded part where, rectangle was unequally divided (See fig. 1).

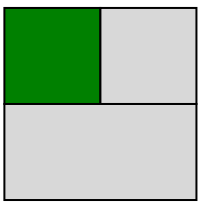

Figure 1. Problem asked on day 1: name the fraction

There were three sets of answers for the problem – a. 1/3 b. ¼ and c. 1 ½. For each answer the EML teacher probed other students to ask questions to other students to understand clearly how they reached to that answer. The student presenting her answer 1 and ½ while answering to the questions by other students said that she assumed that the big rectangle in the figure is a whole and therefore the non-shaded portion of the figure is 1 and ½. After this episode in the next round of exercise of naming fractions maximum students used the approach of deciding the whole first and then accordingly coming up with the name for the shaded part. It was apparent that students were influenced by the solution strategy of that particular student and however they all were mathematically correct, they were reaching to different names for fraction shaded, depending on their choice of the whole.

During de-brief of this class, teachers challenged the idea for promoting choosing different wholes and raised their concern about how can students the unlearn this, so that they will come up one answer.

> "I loved when you were getting their guesses, their educative guesses about what the second picture, where it was divided into three unequal parts, you listed their three guesses and one child had 1/3rd, one with 1/4th and other came up with 1 and a half. And she was the only one admitted publicly that getting that answer and no one else admitted that and there is little bit of discussion of how she got that and which I kept thinking that wow she is great, well when we looked at the journals what happened is several of the students convinced themselves that her method is the right method instead of a wrong method." (Tr. in EML-debrief)

Another one,

> "Well, it is not wrong but again I keep going back to my thought that wow it is genius, you put it so eloquently that she pursued the whole and that's how she got one and a half, but my question is… my observation is now what we do tomorrow, with all of these other kids, who have convinced themselves, that that is how we come up with answer?"(Tr. in EML—debrief)

The measure chunk of the discussion was taken up by these questions, whether the method is wrong in itself and what should we tell students in order to teach them naming of fractions.

DISCUSSION

We discuss the analysis mentioned above in two sections. One based on Lave and Wenger's (1991) idea of *legitimate peripheral participation*, we attempt to understand how each setting is contributing to the periphery and allowing teachers to take insider and outsider perspective on teaching practice. Secondly, we speculate how teachers' involvement is related with the teachers' questioning within the duration of the program and again within the features of the setting; where teachers are "co-planners".

Legitimate Peripheral participation

The contracts between teachers characteristics across the settings, lead us to think more about what is been facilitated by the setting in each of that case and how is that allowing teachers to take insider as well as an outsider perspective. Lave and Wenger's concept of legitimate peripheral participation helped us to think about the periphery that the features of the settings are building. Lave and Wenger define legitimate peripheral participation as the one, which allows more intensive participation and peripherality provides empowering position. In the EML setting the fact that teachers' suggestions will be actually tried in the next class, is part of the design and that gives them empowerment – to give suggestions. We saw that teachers gave these suggestions in very concrete form and that is possible because they were all practicing teachers. However the tricky part is, teachers never get an opportunity to give suggestion to someone else and see the enactment of their suggestions, on the contrary, often teachers are told what is to be done. We valued this new experience that teachers are receiving during the EML as a space creating an outsider perspective for them, where they are acting as a resource but not actually responsible for teaching. We are not sure where does this experience will lie on the range of authentic and inauthentic experience situated in practice, but it certainly created a safe periphery for the teachers to be empowered. Further this empowerment has to result in the intensive participation because it was their own resources, which have been tried out and seen by everyone. However the intensive participation was heavily shaped by their individual interests, which they brought with themselves as practicing teachers. These intrinsic interests allowed them to be an insider, which allowed them to understand teaching rom teacher point of view. Being able to experience inside and outside of the practice is not completely new regime of talking about experiences and have been talked by Lortie (1975) as apprenticeship being a student and then being a student teacher; by Dewey (1938) where he discusses the divide between theory and practice, also while explaining *educative experiences* in contrast to *mis-educative experiences.*

Evolution in teachers' questioning and teacher involvement

The continuous force of identifying relevant teaching practices and changes in it, co-planning for those practices and observing the actual enactment of those practices creates a complex space for continuous reflection, leading to not only change in the discourse of the teachers' discussion towards the end of the program but also in how teachers question and what they notice from the class. During the later days teachers gave many comments, which were specific to students, as some of the teachers preferred to follow a one particular student's progress in those 5 days. What different teachers decided to follow in those 5 days turned out to be an important factor of the discussion during days 3, 4 and 5. For example some teachers focused on a particular student, and started discussing what that student said in the class, what is she writing in the textbook, what she might have thought, etc. Whereas some teachers followed use of textbooks by the EML teacher and discussed about how they use textbooks and how they found the use of textbooks here and how in future they plan to use the textbooks. In summary, the range of discussion and topics was wide because of the varied interested that individual teacher or groups of teachers were pursuing.

As we mentioned earlier this complex space leads to duality of perspective. But we strongly believe that the duality of experience is possible because the participants are practicing teachers and they come with the experiences of the classroom and knowledge about students. During these five days, the teachers pursued their own interests, their own challenges. Even though the EML is a community activity, there was an individualised involvement of interests. As we mentioned earlier that teachers followed one specific student to understand process of teaching is empowering and also unusual, which they generally unable to do in their own class. This individualized freedom, changed teachers' questioning domains. Teachers stopped worrying about whether all students are looking at the teacher when the teacher is speaking, moreover their attention turned to students' responses and their thinking.

CONCLUSION

Based on our experience with teachers' participation characteristics in EML we argue that being able to inside and outside the practice is an empowering position for teachers. Often education researchers enjoy this position. However creating such experience is challenging and EML is one of such kind of setting facilitating the dual-perspective experiences. We also suggest that the duality of the perspective was possible due to the participants' experience. As each of them was a practicing teacher, they could view teaching from a teacher perspective, where as the role of co-planner gave them empowerment to have a voice in what is happening in the class whereas also experienced reduced responsibility as they were not the teachers this time.

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