Professional development in ‘Mathematics in play’

A case study

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Two foci in this session

- Teacher learning in the context of early childhood education (ECE)
- Methodology: double coding a case study

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Research context

- University of Applied Sciences
  - Educational field provides research questions
  - Educational field benefits from research results
  - Teachers as co-researchers
  - Bridging theory and practice

Context

- Mathematics in play - project
  - Early childhood education (ECE) teachers' search for stimulating mathematics in children's spontaneous play
    - Together with researchers
  - Stimulating children's learning
  - A learning environment for professionals
    - Focus in this presentation

Keijzer, R., Boland, A., Van der Zalm, E., & Peltenburg, M. (2020). Mathematics in play. *EAPRIL 2019 Conference Proceedings* (pp. 13-24). EAPRIL.

Theoretical background

- Professional learning community (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006; Henrichs, Slot, & Leseman, 2016)
  - teachers, teacher educators, researchers
- Teacher learning outcomes (Bakkenes, Vermunt, & Wubbels, 2010)
  - knowledge, beliefs, practice, intentions, emotion
- Stimulating learning in spontaneous play
  - Interaction: exploring, connecting, enriching (Damhuis, Van der Zalm, & Boland, 2016)
- Mathematics as human activity (Freudenthal, 1991; Gravemeijer & Terwel, 2000)

Research question

What are characteristic of a teacher's learning and development in a heterogeneous PLC, consisting of ECE teachers, educators and researchers, that is focused on stimulating young children's language and mathematics development in the context of spontaneous play?

Method – case study

- Six PLC-meetings
  - Learning environment for teachers
  - Dialogues are transcribed
- Selecting case: Oumnia
- Selecting Oumnia's input in the six meetings
  - A set of quotes
- Coding two aspects
  - Hypothetical learning trajectory
  - Aspects in professional development
- Interpret Oumnia's development over time
  - Explaining model

Structure PLC-meetings

- ‘Exploring’, ‘connecting’, ‘enriching’ in the context of mathematics learning
  - video
  - photo
  - teachers’ practice
- Communication focused on ECE teachers’ practice
  - ‘picture novel’
- Reflecting on learning objectives
  - and how these objectives can be established by means of spontaneous play

Coding scheme for each PLC meeting

hypothetical learning trajectory

	knowledge	beliefs	practices	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

HLT1: teachers intuitively and implicitly refer to children's mathematical activities and nature of interaction,
HLT2: teachers next refer to their own practice and more and more reflect on this practice in terms of children's mathematical activities and nature of interaction,
HLT3: teachers use these reflections in developing their practice, and
HLT4: discussing mathematical activity and nature of interaction in teaching in general.

Bakkenes, I., Vermunt, J. D., & Wubbels, T. (2010). Teacher learning in the context of educational innovation: Learning activities and learning outcomes of experienced teachers. *Learning and Instruction, 20*, 533-548.

PLC meeting 1 - introduction

Observation:

In the meeting Oumnia tells what she does in her group. She furnishes her room for a new theme and allows the children to play: **'Next week we start a new theme, spring. That first day the children are playing, I look what they are actually doing.'** She especially has an eye for what the children do with what she prepared: **'I once hang a measuring tape in the room. Children were asked to stand aside the tape to measure their length. One of the children took the tape. He wanted to measure clothes. This was so beautiful. I thought a made something and this is what we are going to do with it. But the children discovered other things to do with it.'**

PLC meeting 1 - introduction

	knowledge	beliefs	practices	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

HLT1: teachers intuitively and implicitly refer to children's mathematical activities and nature of interaction,
HLT2: teachers next refer to their own practice and more and more reflect on this practice in terms of children's mathematical activities and nature of interaction,
HLT3: teachers use these reflections in developing their practice, and
HLT4: discussing mathematical activity and nature of interaction in teaching in general.

- enthusiasm on children discovering mathematics (HLT1-emotion)
- reflecting on arranging teaching practice (HLT2-practices)
- showing intuitive knowledge on children's mathematics (HLT1-knowledge)

PLC meeting 2 – interaction/mathematics

Observation:

In this meeting Oumnia tells about the domain of measurement. She shows how she reflects on aims for this domain. Moreover, she recognizes mathematics being omnipresent, and that this helps her in her practice: 'When you discover it is everywhere and this can be used in spontaneous play, we have a win-win-situation.'
Oumnia also shows she knows about the domain of geometry and what spontaneous play is related: '(…) constructing with general construction material and geometric construction material.' Moreover, she knows how to describe relations between interaction modes and mathematics on a more general level, namely when presenting discussing day and week planning with children as a way of using a meaningful simple scheme.
Oumnia observes children's mathematical discoveries and recognizes this as a consequence of the learning environment she developed: 'He actually started comparing measurement units, while I in fact did not aimed at mathematics.' This awareness leads to new ideas for her practice.

PLC meeting 2 – interaction/mathematics

	knowledge	beliefs	practices	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

HLT1: teachers intuitively and implicitly refer to children's mathematical activities and nature of interaction,
HLT2: teachers next refer to their own practice and more and more reflect on this practice in terms of children's mathematical activities and nature of interaction,
HLT3: teachers use these reflections in developing their practice, and
HLT4: discussing mathematical activity and nature of interaction in teaching in general.

- recognizing mathematics is omnipresent, which support practice development (HLT2-practice; HLT3-practices)
- describing relations between interaction modes and mathematics on a more general level (HLT4-knowledge)
- awareness children's mathematics leads to new ideas for her practice (HLT3-intentions)

PLC meeting 3 – picture novel

Observation:

In the meeting Oumnia reflects on what another ECE teacher brings in, using generalized statements on interaction modes: **'All depends on what children come up with. If they are talking about it, you are connecting. When you take the initiative, it is enriching.'**. However when Oumnia reflects on her practice the distinction between 'connecting' and 'enriching' is less clear: **'I ask this quite often. I wonder whether I am enriching or actually still connecting.'** She emphasizes that these reflections make her aware how one can notice children.

Oumnia recognizes in the situation where toddlers are in a row for the 'ice cream shop' the domain numbers and operations: **'They could say: "I see two," recognizing an amount. And then: "Surely two ice creams," That is their way of counting "How many ice creams do I have? How many do I want to buy?"'** Next she reflects on her own teaching: **'When I arrange the room, I think: "(…) What aims are stimulated?" But when the children play, spontaneously more is coming forward (…).' Oumnia here implicitly names the mathematical activity arranging the room leads to.**

PLC meeting 3 – picture novel

	knowledge	beliefs	practices	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

HLT1: teachers intuitively and implicitly refer to children's mathematical activities and nature of interaction,
HLT2: teachers next refer to their own practice and more and more reflect on this practice in terms of children's mathematical activities and nature of interaction,
HLT3: teachers use these reflections in developing their practice, and
HLT4: discussing mathematical activity and nature of interaction in teaching in general.

- generalized statements on interaction modes (HLT4-knowledge)
- implicitly naming mathematics in relation to children's learning environment (HLT1-practices)

PLC meeting 4 – Oumnia's picture novel

Observation:

During the fourth PLC meeting Oumnia's shares her picture novel, on building a Lego lighthouse. The children use a picture as example, showing a red lighthouse with a clear white strap. When discussing her picture novel, Oumnia names objectives, for example concerning the use of informal measuring instruments, like a footstep. In the discussion on objectives she shares her idea that for certain objectives the teacher should demonstrate to help children to learn.

Oumnia explains what she did in the lighthouse situation she presents: **'(…) at first I just joined, then: "Well, miss see, we are building a lighthouse." But it fall down again and again. I sat there. (…) So I said: "Well, boys, how can we make it does not fall down again, because I see it does over and over!" (…) And then a child said (…): "Miss, we might need adhesive tape!"'** Oumnia next provides adhesive tape, after which she leaves the children discovering that Lego building is unsuccessful when the bricks are glued together. Doing so, Oumnia shows previous considerations influence the learning environment she prepared for the children and also that she follows the children in their thinking. She lets children solve problems and tells she is curious what solution they will come up with. Moreover, Oumia states that she enjoys children who, like in the example, look for solutions. She provides children the opportunity to first draw the lighthouse and next build it. She thus shows how her previous considerations lead to children's curiosity. She also demonstrates how she reflect on experiences on a general level and considers how her experiences fit with how she choose to develop the learning environment. New experiences convince Oumnia more and more on the power of open, stimulating questions and she indicates she really enjoys all these new experiences.

PLC meeting 4 – Oumnia's picture novel

	knowledge	beliefs	practices	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

HLT1: teachers intuitively and implicitly refer to children's mathematical activities and nature of interaction,
HLT2: teachers next refer to their own practice and more and more reflect on this practice in terms of children's mathematical activities and nature of interaction,
HLT3: teachers use these reflections in developing their practice, and
HLT4: discussing mathematical activity and nature of interaction in teaching in general.

- sharing ideas on objectives the teacher should demonstrate (HLT3-beliefs)
- ideas and insights have consequences for practice development and her interaction with children (HLT3-practices)
- general idea: the power of open, stimulating questions (HLT4-practices)
- enjoying new experiences (HLT3-emotion)

PLC meeting 5 - objectives

Observation:

Each nationwide objective is written on a piece of paper, enabling teachers in the PLC to place objectives under one of these labels. The resulting ordering in objectives is discussed. In the discussion Oumnia shares her ideas on the objectives. For example she states **'Exploring and describing placing objects in the surrounding space' is a part of 'geometry'. For a significant number of objectives she state how they fit how she developed her learning environment**. She here provides general examples for objectives in the geometry domain: **'For example when they build something and make a ground plan, but that they take a specific perspective.'** Also from the ratio and proportion domain: **'When they built a house, no matter with what they do so, there is a restriction that people from the doll house need to fit in the house.'**. Talking about objectives elicits Oumnia sharing her ideas on the children's level: **'Folding is very difficult for the children. (...) I notice four year old's and even five year olds find this really hard.'** She reasons, that as a consequence for several objectives you need to demonstrate: **'So when you just show things, they next imitate it.'** and **'For using geometrical words, I really think you first need to show. This is needed when you talk about words.'** Oumnia names this showing as 'giving a push'.

Moreover, exploring objectives makes Oumnia reflecting on whether or not she covers all and whether this may be done unconsciously. That she is occupied with this issue when she is aiming at stimulating spontaneous play, is exemplified by her statement: **'And if you had a mathematics textbook, you could read which objectives you work on.'**

PLC meeting 5 - objectives

	knowledge	beliefs	practices	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

HLT1: teachers intuitively and implicitly refer to children's mathematical activities and nature of interaction,
HLT2: teachers next refer to their own practice and more and more reflect on this practice in terms of children's mathematical activities and nature of interaction,
HLT3: teachers use these reflections in developing their practice, and
HLT4: discussing mathematical activity and nature of interaction in teaching in general.

- showing general, but implicit and intuitively, knowledge of mathematics domains (HLT1-knowledge; HLT4-knowledge)
- stating how objectives fit in the learning environment (HLT2-practices)
- providing general examples for objectives (geometry, ration and proportion) (HLT4-practices)
- sharing ideas on objectives one need to demonstrate (HLT4-beliefs)

PLC meeting 6 – objectives

Observation:

The sixth PLC meeting also focuses on aims in teaching. PLC participants discuss objectives for measurement and geometry. Oumnia here repeats how she judges what support children need: **'When you ask children to work on their own, they often experience difficulty. They then really need your help. This is even so if you instructed them earlier. That they are able to built with blocs or show their fantasy is just fine. But certain things like money is a step to difficult for them to do this on their own.'** She next tells how children in her group reason and choose. She here welcomes children's initiative: **'But they were really working on it.'** Oumnia reflects on the learning environment and sees children's mathematical activity. She elaborates this into general considerations on developing her practices.

PLC meeting 6 – objectives

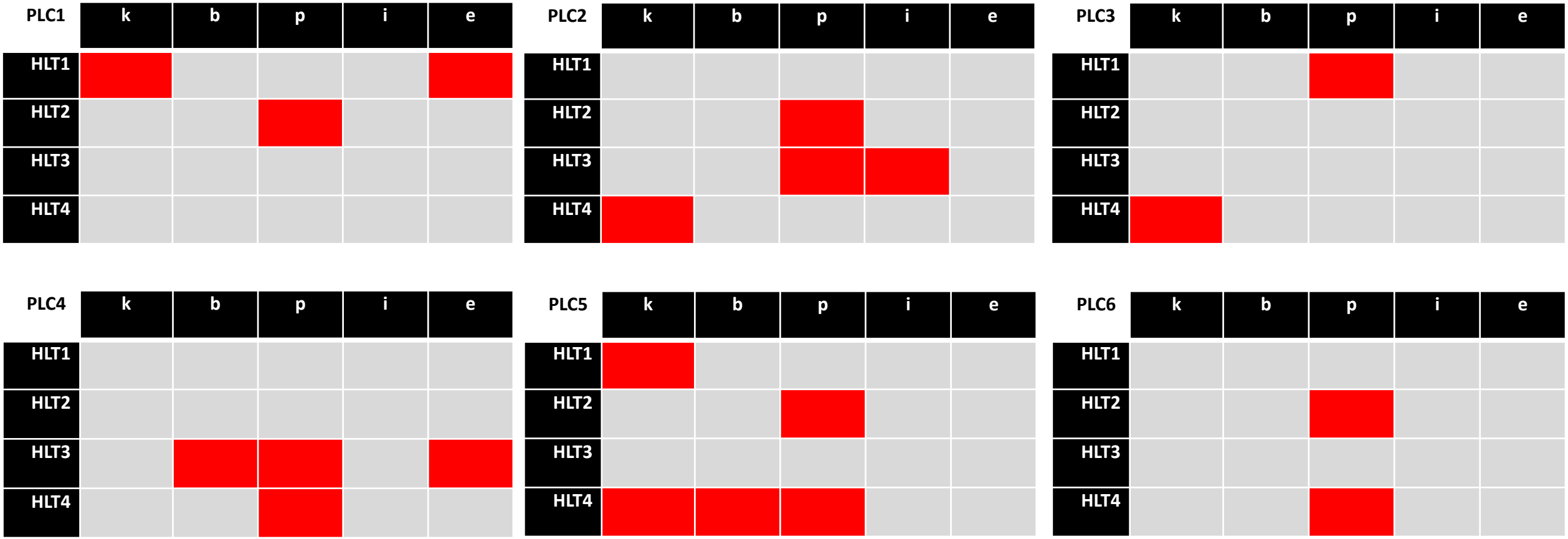
	knowledge	beliefs	practices	intentions	emotion
HLT1					
HLT2					
HLT3					
HLT4					

HLT1: teachers intuitively and implicitly refer to children's mathematical activities and nature of interaction,
HLT2: teachers next refer to their own practice and more and more reflect on this practice in terms of children's mathematical activities and nature of interaction,
HLT3: teachers use these reflections in developing their practice, and
HLT4: discussing mathematical activity and nature of interaction in teaching in general.

- reflecting on the learning environment and children's mathematical activity (HLT2-practices)
- elaborating this into general considerations (HLT4-practices)

Development - overview

knowledge, beliefs, intentions, practices, emotions



HLT1: teachers intuitively and implicitly refer to children's mathematical activities and nature of interaction,
HLT2: teachers next refer to their own practice and more and more reflect on this practice in terms of children's mathematical activities and nature of interaction,
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Reflection

- Coding describes interaction between
  - Activities in the PLC
  - Oumnia contribution in PLC
  - Other contributions

Analysis

- On the whole: hypothetical learning trajectory as expected; resulting from structure PLC-meetings:
  - 'exploring, connecting, enriching' and mathematics
  - picture novel
  - reflection on objectives/aims
- Rapid gearing between general statements and descriptions of one's own practice
  - translating input in meetings
  - explicating practice based theories developed earlier
- Gaining knowledge of 'exploring, connecting, enriching' and mathematics results in critical reflection
  - evoked by reflection on (national) objectives: can they be obtained in spontaneous play settings

Discussion

- Limitations case study
  - Development in time depends on what (coincidently) is discussed in the PLC
  - Oumnia is typical teacher, in a diverse group

Conclusion

What are characteristic of a teacher's learning and development in a heterogeneous PLC, consisting of professionals in preschool and kindergarten, educators and researchers, that is focused on stimulating young children's language and mathematics development in the context of spontaneous play?

- Developing gradually more and more ideas and opinions on developing mathematics in spontaneous play.
- Gearing between general notions and teacher's own practice.
- Reflection on objectives and how these can or cannot reached in spontaneous play.

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Please share your ideas

- Educational field provides research questions
- Educational field benefits from research results
- Bridging theory and practice

- Coding the development in a case study
  - from two perspectives