

Professional mathematics teacher identity: analysis of reflective narratives from discourses and activities

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Abstract This article focuses on the methodological use of reflective narratives from discourses and activities of an experienced primary teacher as evidence of her professional identity. The teacher's reflective narratives emerge from her participation in a 3-year developmental and research project, Learning Communities in Mathematics, conducted at the University of Agder (UiA) in Norway. As background for our study, we firstly present the teacher in action with her sixth-grade pupils in a mathematics lesson, and then analyse selected clusters of reflective narratives from different empirical situations in the project. We have identified four identity indicators, which have been elaborated and organised thematically, related to the teacher's engagement and critical alignment in the community of participants: (1) Positioning in relation to pupils, (2) Reflecting on developing a workshop model in teaching, (3) Integrating and expanding models of teaching and (4) Challenging positioning in relation to didacticians. These indicators provide evidence of the teacher's professional identity. We suggest that the emergence of these indicators also gives empirical evidence of professional teacher identity development.

Keywords Professional mathematics teacher identity · Social theory of learning · Narrative approach · Reflective narrative · Identity indicator

In recent years, identity has received the attention of researchers from a wide variety of theoretical and methodological approaches in social and human sciences. The growing

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interest in educational research has also been prominent (Boaler 2002; de Freitas 2008; Gee 2001; Hodgen 2011; Sfard and Prusak 2005). In contrast to psychological theories of identity that focus on a person's sense of belonging to a group or the person's sense of achieving within the norms of the group, identity is also viewed as a function of participation in different communities (Boaler et al. 2000; Lave and Wenger 1991; Wenger 1998). Based on this view, identities are not stable but dynamic and situated, emerging in talk in different situations of everyday life routines (Antaki and Widdicombe 1998). Identity changes across time (Lemke 2000) and space (Gee 2001) depending not only on inner or individual processes, but also on social and contextual interactions (Juzwik 2006). The notion of teacher identity is considered to be a key theme for future directions of research in a sociocultural perspective (Lerman 2006; Sfard 2008). Identity has also been related to mathematics knowledge in teaching, building on the perspective of viewing "knowledge as situated, social and distributed" (Hodgen 2011, p. 36). The notions of story and narrative have been highlighted and placed in the context of teachers' professional identities, capturing the situated aspect of teacher knowledge (Stein et al. 1998; Hodgen 2011). According to these authors, the situated nature of becoming a mathematics teacher involves a process of identity change.

In an attempt to approach the concept of identity, conceiving it as an integral aspect of social theory of learning as well, we have in an earlier study focused on indicators of socially situated identity that are enacted in discourses and activities of an experienced, primary teacher called Agnes (Bjuland et al. 2009). A pragmatic perspective has been applied in this particular study, focusing on activities in four different situations. The analyses revealed that identity can be characterised as modulated, changeable and flexible according to the situation and the way the teacher made meaning of it. Two indicators of modulated identities emerged from the teacher's discourses: instances of integration and instances of transformation.

In this article, our first aim is to further develop the analytical tools used in Bjuland et al. (2009) by including Sfard and Prusak's (2005) suggestion that "identities may be defined as collections of stories about persons or, more specifically, as those narratives about individuals that are *reifying*, *endorsable*, and *significant*" (p. 16). Indicators of professional identity may therefore be detected through text and discourse. For our study, Agnes is telling narratives about herself to other participants produced in different situations in the context of the Learning Communities in Mathematics¹ (LCM) project. In these situations, her utterances are defined as *reflective narratives* when she looks back and consciously reflects about personal experiences in the project and relates those experiences to her teaching practice.

Ponte and Chapman (2008) claim that a teacher's professional identity is a complex notion, which must be considered on two levels, individual and community. Our second aim in this article is to delve into the construct of professional teacher identity by focusing on Agnes's practice as expression and constitution of her professional identity, taking into account that this professional identity is also shaped through her participation in the LCM community (for further details about LCM as a community, see e.g. Jaworski et al. 2007; Bjuland and Jaworski 2009). All our data have been collected in this context. LCM was designed at the University of Agder (UiA) in Norway as a three-year developmental and research project. The project involved a team of didacticians² and teachers working at all levels in school, from Grade 1 through Grade 13.

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² "Didacticians in the project were mathematics educators in a University in Norway, working within a Department of Matematikk Didaktikk" (Bjuland and Jaworski 2009, p. 37).

The following research questions have been formulated:

1. How do the reflective narratives of an experienced primary teacher about discourses and activities provide evidence of the professional identity of the teacher?
2. Which indicators of a teacher's professional identity emerge from participation in discourses and activities related to work situations?

In our first question, there is embedded a concern related to methodological issues. We try to provide a way to make the shaping of teacher identity explicit through narratives (Hodgen 2011). In a recent study, de Freitas (2008) focused on how teachers enacted identity through narratives in classroom discourse. De Freitas explored how four high-school mathematics teachers shifted between procedural discourse and personal narratives (e.g. stories about horse races or life stories of adventure) in their classrooms. Rather than examining the function of personal narratives in the mathematics classroom (de Freitas 2008), we focus on how teacher identity is enacted through reflective narratives from personal experiences that were derived from participating in the LCM project.

In answering the second question, we are inspired by the notion of “acts as indexical” as mentioned by Holland et al. (1998). We interpret the teacher's particular acts and discourses in different situations as such indicators and detect indicators of professional identity through a particular teacher's reflective narratives. More specifically, clusters of reflective narratives are constructed and labelled as different indicators of professional identity. When Agnes looks back and consciously reflects on her personal experiences and reflects about herself as a teacher, we are able to capture aspects of her professional teacher identity. We suggest that the construction of these identity indicators can provide further evidence of professional identity development or identity change (Hodgen 2011) of an experienced teacher influenced by her participation in the LCM project.

Teachers' professional identity

We are aware of the challenges in defining a complex concept such as teacher identity. Consequently, we introduce here work conducted earlier, which points to different perspectives in this area of study. Philipp (2007) claims that teachers know, believe, feel, participate and belong, thereby suggesting that the term *teacher identity* emerges as a sociocultural construct that includes all of these aspects of teachers' lives. Collopy (2003) defined teacher identity as “the constellation of interconnected beliefs and knowledge about subject matter, teaching, and learning as well as personal self-efficacy and orientation towards work and change” (p. 289). This diversity of definition is supported by the work of Beijaard et al. (2004) who selected and systematically analysed 22 studies relating to teachers' professional identity in educational research in the period 1988–2000. In these studies, the concept of professional identity was defined in many different ways or in some cases not defined at all.

A model of identity has been developed by Carlone and Johnson (2007). This model outlines three interrelated dimensions for a person to enact a particular identity: *competence*, *performance* and *recognition*. In our work, we do not aim to impose a particular professional identity onto Agnes by trying to fit our data to a particular model. Instead, we identify reflective narratives produced by Agnes based on her own utterances in different contextual situations from the LCM project. In defining a teacher's professional identity, we follow Ponte and Chapman (2008, p. 242) who suggest that this construct

may be seen as the teacher's "professional self" or an instance of a social identity. It includes the way teachers see themselves as professionals, their relationship with authority, and their professional autonomy.

In agreement with these authors, we maintain that a crucial aspect of a teacher's professional identity is expressed in his or her participation in the processes of interacting and collaborating with other teachers, and "reflecting on their own activity and about themselves as teachers" (p. 242). We define the constitution of professional identity of a teacher as a continuous process of appropriating knowledge through participation in the educational context. In our case, Agnes's identity is related to the engagement in *inquiry activity* within the *community* of the LCM project. The notion of *community of inquiry* is crucial in our approach since "inquiry is developed as one of the norms of practice within the community and individual identity develops through reflective inquiry" (Jaworski 2006, p. 202).

Narrative approaches to identity

Early studies related to narratives in the learning of mathematics were inspired by Bruner (1986) and his focus on imaginative and paradigmatic ways of using experience. Burton (1999) emphasises the importance of approaching the learning of mathematics in classrooms through narrative. According to Burton, narrative helps learners to understand mathematics and illustrates their learning process. Burton points out that paradigmatic narrative seeks to establish generalities from special examples, while imaginative narrative attempts "to tell engaging and believable stories which become exemplifications" (p. 21). Burton emphasises the discursive nature of narrative in order to underline that there are perceived differences between these two narrative forms.

In accordance with Labov (1972), we define "narrative as one method of recapitulating past experience by matching a verbal sequence of clauses to the sequence of events which (it is inferred) actually occurred" (p. 359). Labov defines a *minimal narrative* "as a sequence of two clauses which are *temporally ordered*" (p. 360). This structural definition offers a basic criterion that is useful in distinguishing narrative from non-narrative discourse. In our work, each utterance from Agnes is conceived as a detachable unit of discourse following Labov's criterion of minimal narrative discourse.

Another important contribution by Gee (2001) is the suggestion that a person's identity is related to being recognised in a given context. Holland et al. (1998), however, proposed that identities can be related to self-understandings when people articulate to themselves and to others their perceptions of themselves. According to Sfard and Prusak (2005), these approaches to identity are crucial since they offer some insights: "By foregrounding the "person's own narrativizations" and "telling who one is"" (p. 16), the notion of identity is linked to the activity of communication, which is conceived broadly and includes self-dialogue. In Bjuland et al. (2009), talk is conceived as an element of the expression of identities, and from this approach "identity is represented and shaped through the social and discursive practices available to individuals and groups at particular moments" (p. 115).

In Sfard and Prusak's definition of identities (2005) "as a collection of stories about persons" (p. 16), the narratives are told by an author, about an identified person, to a recipient. These persons may be different or may be the same person. These authors also distinguished between two subsets of possible narratives about persons: *actual identity*,

narratives consisting of stories about the actual state of affairs, and *designated identity*, narratives presenting a possible state of affairs. The first subset is usually told in the present tense and formulated as factual assertions (e.g. “I am a good driver”). The latter subset of narratives presents an anticipated state of affairs (e.g. “I want to be a doctor”).

Developing teacher identity in classrooms

In recent years, a number of studies have considered the notion of teacher identity and professional change in mathematics education. Hodgen and Askew (2007) illustrated in a case study how a particular primary teacher became engaged in mathematics despite initial avoidance of the subject. These researchers concentrated on the developing narrative constructed by this teacher in her relationship with mathematics teachers and school mathematics. She developed an identity as a teacher of mathematics in which her emotional relationship with mathematics shifted from a disconnection with the subject to a position of authority, believing in her own role of appropriating mathematical knowledge. Hodgen and Askew maintain that a primary mathematics teacher’s identity “could be enacted in a variety of distinct communities, including the classroom, planning sessions with colleagues, the wider school, community, professional communities and more” (p. 473).

Ponte and Chapman (2008) see the development of a mathematics teacher’s identity as a continuing and dynamic process shaped by multiple influences. In their review of studies whose aim was to promote preservice teachers’ identity, two themes emerged. One theme relates to aspects of reflection. More specifically, a teacher’s reflection on practice and on self before, during and after the practice plays an important role in fostering his or her identity. The second theme of the studies is related to the fact that investigating practice may provide a powerful arena for preservice teachers to foster their identity. Such an investigation assumes “an inquiry attitude that could include a more systematic process of questioning practice, collecting and analysing data and reporting results” (p. 248).

We are inspired by the two research themes concerning teachers’ reflection on practice and the investigation into practice in order to foster teacher identity (Ponte and Chapman 2008). Our focus is related to identities that are dynamic and situated, emerging in social activity.

Context of study

The context of this study was within the LCM project. A brief presentation of the principles and activities in the project follows. The aim of the LCM project was to build communities of inquiry among teachers from eight local schools and didacticians from UiA to develop their teaching and enhance their learning of mathematics. The project began with 6 months (spring 2004) of preparatory work by didacticians at the University. This was followed by 3 years of project activity with schools involving twelve workshops spread uniformly across the first 2 years (from autumn 2004 to spring 2006) and four workshops in the third year (autumn 2006 and spring 2007). The project concluded with a period of 6 months (autumn 2007) when didacticians reflected on the principles and activities.

Activity with schools followed three phases, each lasting one school year. The first phase mainly involved *community building*, bringing didacticians and teachers together to get to know each other and to learn to communicate. Phase 2 focused on “*developing thinking about inquiry* and on *planning for the classroom*” (Jaworski 2007, p. 17), while

phase 3 was characterised by “*focusing on schools’ own goal for development*” (p. 17), discussing in workshops how to design “school-based activity” according to “self-declared goals”. The three and a “half-hour workshops” had, in general, the same structure: (1) Introducing a mathematical theme (e.g. algebra, geometry and probability), (2) Small-group activities working on mathematical problems, (3) A second section of small-group activities involving an activity for the classroom and finally (4) Plenary presentations. Didacticians and teachers worked together in both sections of the small-group activities. Sometimes, teachers cooperated with colleagues in homogeneous groups (teaching at the same grade levels), while in other workshops, the activities were organised in mixed groups.

One important feature of the project was the establishment of teacher teams in each school. These teams organised and conducted internal school meetings to plan activities for the classroom that were related to ideas presented in workshops. Didacticians were willing to participate in such planning in order to have contact with schools, to provide help as requested by the teachers and “to record on video any subsequent classroom innovation” (Jaworski 2007, p. 18). Details related to school work resulting from workshops can be found in Bjuland and Jaworski (2009), and in Jaworski et al. (2007).

The LCM project sought to develop *inquiry communities* of teachers and didacticians, inquiring and learning together. This construct is derived from the idea of participation in a *community of practice* (Lave and Wenger 1991; Wenger 1998). When designing the project, didacticians were inspired by Wenger’s notion of *belonging* to a community of practice, comprising of three elements: *engagement*, *imagination* and *alignment* of participants. Bjuland and Jaworski (2009) have briefly commented on these terms: “members of a community engage in the practice(s) of their community ... they bring imagination to their own participation and they align (literally ‘line up’) with the norms and expectations of the communities” (p. 22). These authors emphasise that when participants’ alignment becomes *critical*, then a community of practice becomes a community of inquiry. A teacher’s alignment is said to be critical when the teacher engages in inquiry processes. Full details about these theoretical principles are elaborated on in earlier articles (e.g. Jaworski 2006).

Research method

We have chosen to focus on one of the participants of the project, the teacher Agnes. She had been a primary teacher (in different school subjects) for about 35 years. She had also been a teacher supervisor for prospective teachers for about 28 years. Agnes was chosen because of her engagement and willingness to participate in the different activities of the LCM project, which formed the context for the data collection. From discussions in workshops, both in plenary sessions and in small-groups sessions, Agnes seemed to be well aware of the notions of *inquiry community* and *critical alignment*.

Table 1 illustrates the empirical material from our study, chronologically presented, showing the teacher Agnes in activity in five different situations. All these situations have been audio- and/or videotaped and transcribed. The data analysis and interpretation, focusing on reflective narratives, are based on the discourses and activities of Agnes. We are aware that the process of capturing the teacher’s identity is not represented by a single episode. This is an ongoing process of advances, retreats and turns. The selected situations may appear unconnected, occurring over a period of 2 years. We will in the following argue that these situations illustrate important moments for Agnes as a participant in the project.

Table 1 Chronological overview of the empirical material

1. Situation	2. Situation	3. Situation	4. Situation	5. Situation
Mathematics lesson 13 April 2005	Interview 31 January 2006	Focus group 13 March 2006	Workshop 16 28 March 2007	Workshop 16 28 March 2007
Agnes's introduction of the "diagram task" to her pupils. Present: Pupils, Agnes and the didactician Alf.	Collective, semi-structured interview Present: Agnes and the didacticians: Alf, Pia, Odd, Dag.	Collective, semi-structured interview. Present: the teachers Agnes, Egil and Fredrik, the school principal, and the two didacticians Alf and Eli.	Participation of Agnes in a small-group discussion. Present: the teachers Agnes, Arnold, Heidi, David, the didacticians Leo and Odd, and two visiting doctoral students.	Plenary presentation by Agnes after the small-group discussion.

Data from the above situations have been selected from the data bank of the LCM project. The interview in situation 2 was arranged specifically for our study. The first situation (1) differs from the others, (2)–(5), since it illustrates Agnes in action in a mathematics lesson from her first year as participant in the project. Situation 2 presents her reflections on pupils' learning processes and her reasons for using a particular mathematical task presented in this lesson. In situation 3, she reflects on being a participant in LCM. The data in situations 2 and 3 were collected in the second year of the project. Finally, situations 4 and 5 provide insight into her reflections on participating at the conclusion of 3 years in the project. In summary, the first two situations focus on an early teaching episode of Agnes and her later reflection on this episode, some 9 months later. The last three situations illustrate her overall reflections from the LCM project. Agnes's utterances produced in situations (2)–(5) are defined as *reflective narratives* as she looks back and consciously reflects on past experiences in the project.

In the analyses of situations (2)–(5), we have adapted Sfard and Prusak's (2005) narrative framework. We are aware that as "a narrative, every identifying story may be represented by the triple ${}_B A_C$, where A is the identified person, B is the author, and C the recipient" (p. 17). However, we will not include such triples in our analyses since we are mostly concerned with identifying reflective narratives as told by the identified person about herself to other people (${}_A A_C$). Sfard and Prusak emphasise the importance of the first-person self-told identities. In our analyses, we are concerned with reflective narratives told by Agnes about herself to other recipients: participants in the two interviews (situation 2 and situation 3), participants in a small group (situation 4) and to participants present in the LCM workshop (situation 5). More specifically, the analyses are performed in the following way in order to locate the identity indicators:

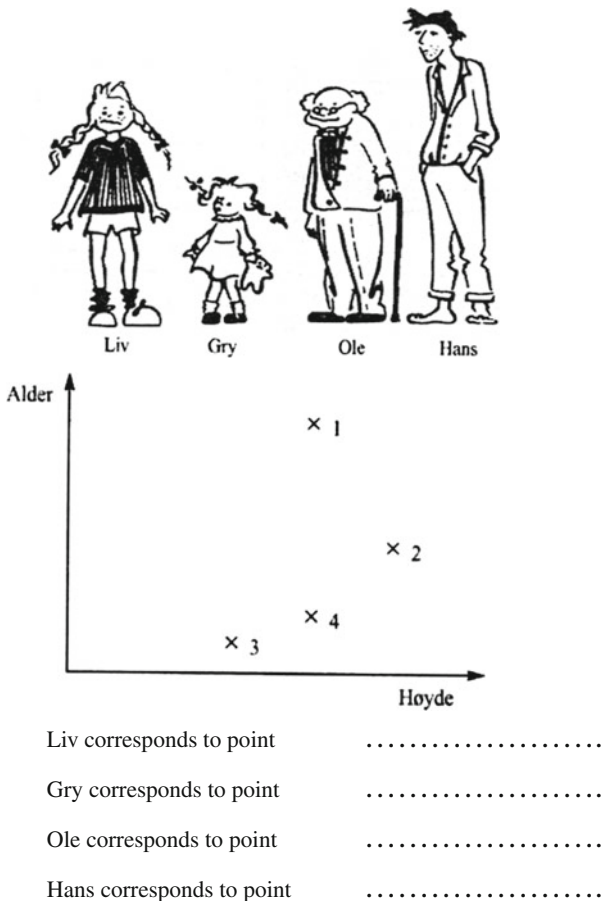
1. Three classroom vignettes (1st situation) are introduced to provide background knowledge for the analyses.
2. Reflective narratives are identified from the four other situations. These narratives are identified from Agnes's self-told utterances in these situations (${}_A A_C$, Sfard and Prusak 2005). Agnes looks back and consciously reflects about personal experiences in the project and relates those experiences to her teaching practice.
3. Reflective narratives (3–5) identified from different situations are clustered to construct and label an identity indicator.

4. In the analysis, there is also an argument that the identity indicators are more convincingly located if the cluster has been constructed from reflective narratives produced over a period of time in the LCM project (from different situations).
5. In one of the clusters, we use the framework of Sfard and Prusak to include a narrative given by the Principal of Agnes, speaking of Agnes both to her person and to some other participants ($_{BA_{A,C}}$), thereby, introducing a person of authority with respect to Agnes's professional identity.

Classroom vignettes as background knowledge for approaching the analyses

Three vignettes from Agnes in action with her sixth-grade pupils are introduced in order to illustrate Agnes' positioning in relation to her pupils. The dialogue below provides a glimpse of Agnes, introducing the following task (the diagram task) for her pupils:

TASK: Write down which person corresponds to each of the points in the diagram (the Norwegian words *alder* and *høyde* mean age and height, respectively).



The original version of this task was designed at the Shell Centre in England (Bell et al. 1986) with seven people in the picture.

Before the 27 pupils (13 girls and 14 boys) were divided into collaborative small groups of two or three, Agnes presented the task on an overhead projector with the pupils sitting around in a semi-circle. The task challenges the pupils to make transitions between concrete data (figure), abstract diagram and written text. A detailed analysis of the proposed task can be found in an earlier study (Bjuland et al. 2008a). The first vignette shows Agnes in the role of *presenter*:

- 15 Agnes: Look, this is about Liv and Gry and Ole and Hans. Do you notice anything about Liv and Gry and Ole and Hans? Can you see any differences between them? Kari, what do you see?
- 16 Kari: They have different heights
- 17 Agnes: That's right. Mm. Can you see some more differences? Sofie?
- 18 Sofie: Different age
- 19 Agnes: Yes, that's clear that they are different ages. Yes, then you know that these four persons have been out for a walk and, and then we're going to try to find out where the different persons are [*The teacher goes from her chair towards the screen*]. Who is number one? [*Pointing at point 1 followed by a circular sliding³ up to the picture*]. Who is number two? [*The circular sliding from the picture ends in pointing at point 2*]. Who is number three? [*From point 2 with a decreasing circular sliding without reaching the picture, pointing at point 3*] and who is number four? [*From point 3, a decreasing sliding before pointing at point 4*]. Hm! How can we find this out?

In an earlier study, we identified Agnes's communicative strategies in presenting the task to her pupils (Bjuland et al. 2008b). Three strategies were prominent: (1) The use of the verb *see* and the personal pronoun *you* (singular you in Norwegian), in order to focus the attention of pupils, (2) The posing of open questions, to stimulate the pupils to bring the variables of height and age into the dialogue and (3) The use of both gestures (four consecutive pointings and circular sliding) and speech (questioning), to focus on the transition from figure and diagram and to make connections between people and the labelling of points. The identification of Agnes's communicative strategies and the function of her gestures in this particular context give insight into her manner of presenting the task for her pupils. From this presentation, we learnt that Agnes does not put much emphasis on the diagram, nor is she concerned with the points in the diagram, for instance by focusing on what a point represents. Agnes introduced the task briefly by focusing mostly on the figure.

Two girls had difficulties in seeing the connection between height and age. They looked to Agnes twice for help. The second vignette shows some of the difficulties, identified from the first dialogue between Agnes and the girls, illustrating Agnes in the role of *supervisor* (Bjuland et al. 2008b):

- 113 Pupil 4: But I didn't understand what these labels meant
- 114 Agnes: No. These are which persons? They are [*Linear sliding⁴ along the picture*]. One of those persons is number three [*Linear sliding along the picture*]

³ Circular sliding also framed circular point-slide comprises "pointing with a circular movement of the hand" (Bjuland et al. 2008a, p. 280).

⁴ Linear sliding also framed linear point-slide is "identified when the pupils point and move their fingers along a line" (Bjuland et al. 2008a, p. 280).

followed by pointing at point 3 in the diagram]. One of those persons is number four [*Linear sliding along the picture followed by pointing at point 4 in the diagram*]. One of those persons is number two [*Linear sliding along the picture followed by pointing at point 2 in the diagram*] and so on, aren't they?

115 Pupil 4: Okay, but those then?

116 Agnes: Yes the points one, two, three, four. Those are four different points

In Bjuland et al. (2008b), we identified the communicative strategy of *questioning*. By asking different questions (yes–no, open, specific), Agnes observes that the girls have difficulties in their solution process. The difficulties are related to the coordination of the two dimensions and to the passage between diagram and written text. When the girls express their concerns, Agnes combines verbal explanations and gestural resources (pointing and circular sliding) to make explicit the reasoning behind the movement between the two representational forms, from the figure to the diagram (114), (116).

The third vignette presents a brief discussion from the summing up in the classroom after the small-group work, illustrating Agnes in the role of *coordinator* (Bjuland et al. 2010):

194 Agnes: But you [singular you], what did you [plural you] think when you found out that Hans should be number two?

195 Odd: We thought that he was tall, and he [Hans] was much younger than Ole

196 Agnes: Mm. Yes, so therefore he should be there. Is there anyone else who thought about it? [Silence, 6. sec.] Leo, what did you think?

197 Leo: Eeh, no I (...)

198 Agnes: Eeh, yes, Is there anyone else who thought about it? Let's see, Hans is number two. He had to be there. Why couldn't Hans be there [Points at point 1, diagram] Why couldn't Hans be there, Eli? [The teacher chose Eli from several pupils who raised their hands]

199 Eli: Since he, or if Ole, he is the oldest and then couldn't he [Hans], since he [Hans] is the youngest [of these two]

200 Agnes: Mm. Yes

Agnes poses several questions that have the function of (a) stimulating the pupils to explain how they come up with the particular location for Hans (194), (b) provoking other suggestions (196), (c) repeating and directing to an individual pupil (196) and (d) provoking the pupils to consider a wrong location of Hans (two why-questions) (198). We suggest that Agnes plays the role of *coordinator*, opening the floor for the pupils to present their answers.

Findings

Below, we present four identity indicators that have emerged from analysis of the empirical data of four crucial situations for Agnes as participant in the LCM project. We have used Sfard and Prusak's framework (2005) in order to identify Agnes's self-told reflective narratives ($_{AAC}$) in these particular situations. More specifically, each of the identity indicators has been constructed and labelled from a cluster of reflective narratives told by Agnes about herself to other participants in these special situations of the project.

Positioning in relation to pupils

The classroom vignettes have given a brief glimpse of Agnes in action with her sixth-grade pupils. To present a task, to supervise its execution by the pupils and to coordinate the discussions generated from solutions proposed at the end of the activity are typical actions taken by teachers in the classroom.

The video recording of this particular lesson was shown to Agnes during an interview with four didacticians at UiA about nine and a half-month after the lesson event (2nd situation). In the video, two groups of pupils, consisting of three boys and two girls respectively, were filmed during their collaborative small-group work, working on the diagram task. The boys quickly arrived at a correct solution, while the girls had some difficulties in their solution process (see Bjuland et al. 2008a). In the interview, the didacticians focused particularly on the video clips from the solution processes of the two groups. The reflective narrative, selected from this particular situation, was triggered by a question posed by the didactician Pia towards the end of the interview. The question focused on the girls' difficulties in their solution process:

Pia: And what do you think the difficulties for the girls are exactly?

Agnes: No I think, they didn't manage to see the connection in this diagram clearly, I think, but the fact that they focused on age and height separately, well if they mix the age and the height, then it's wrong. ... So the uncertainty is due to the fact that they had difficulties in starting to work on the task, to do it their way I think, and then in addition they needed confirmation that they had solved the task correctly

Agnes's reflections about the girls' solution process reveal that their difficulties are related to the reasoning strategy of coordination of the two dimensions in the diagram. She also suggests that the girls "mix the age and the height" in the diagram, indicating that the design of the task may provoke some confusion. Agnes has also observed that the girls had difficulties in getting started with the task, and they needed a second round of help in order to confirm their solutions. The reflective narrative shows Agnes's positioning in relation to her pupils, illustrating her sensitivity to the difficulties experienced by the girls in their solution process of the problem.

In the answer to a second question posed in the interview, Agnes reflects on the pupils' learning from their work on the diagram task:

Pia: Agnes what have your pupils learnt when they tried to solve this particular task? What have they learnt?

Agnes: I think... maybe that they have learnt, at any rate, to see the connection between the x-axis and the y-axis... they simply have to transform it (the figures) and put it into a diagram and that I know. ... yes now I'm beginning to bring in other aspects, but I know we struggled with it [the task] at the LCM meeting we had there [at UiA], it would have been so much easier if the height had been placed in relation to how we read the height here ... then I think that they have learnt something about, then they have learnt to reflect about a task, that I think is very important, that they learn to read a diagram...

Agnes suggests that the pupils have perhaps learnt to see the connection between the two dimensions in a diagram and that they are now able to transform data from one semiotic representation (figure) to another (Cartesian diagram). She also relates the pupils' learning processes from the diagram task to her own experience, working on the same task

at a workshop in the LCM project. She confirms the possible confusion provoked by the design of the task, suggesting that the task would have been much easier if the variable height had been located along the vertical axis. The reflective narrative illustrates Agnes's reflection on analysing a mathematical task based both on her own experience with the task and on the pupils' performance.

We are aware of the fact that both reflective narratives are stimulated by questions posed by a didactician. Therefore, it may be the case that Agnes answers the questions in such a way to satisfy the didacticians or in a way that she believes will satisfy the didacticians. The reflective narratives produced in this situation may therefore not be sufficient to claim empirical evidence of Agnes's professional teacher identity.

In order to construct a more convincing identity indicator, the classroom vignettes (April 2005) and the two narratives from the interview (January 2006) have been supplemented by a reflective narrative selected from a small-group discussion at Workshop 16 (March 2007). This narrative illustrates how Agnes positions herself, emphasising her role in the classroom in relation to her pupils:

Agnes: But otherwise, then I believe ... it's maybe my way of being ... I would really let them [the pupils] be engaged, I would let them come up with answers, they have to find out things themselves. I am not [a person] that tells them everything... (Ws 070328_SG2)

In the utterance quoted above, Agnes expresses her positioning as a teacher more explicitly, revealing her actual identity (Sfard and Prusak 2005). Agnes's conception of teaching seems to be that pupils should not be given solutions. She wants her pupils to be engaged and find solutions to mathematical tasks for themselves. The narrative is also closely connected to the first three phases of the Phase Model (see below), in which the pupils are stimulated to explore, investigate and conjecture about mathematical ideas and discuss ideas that are emerging from solution processes in dialogue with their teacher. In the following section, we focus particularly on Agnes's reflections on her own practice in the classroom in relation to the LCM project.

Reflecting on developing a workshop model in teaching

In the reflective narrative below, Agnes confirms the importance of participating in workshops:

Agnes: The workshops at UiA are a great motivation for me ... a motivation to be a mathematics teacher and to develop and try out mathematics in the classroom. (FG_060313)

Agnes's utterance illustrates a minimal narrative (Labov 1972), consisting of a statement that emphasises the relevance of the workshops at UiA. Workshops in the LCM project have inspired Agnes to try out ideas and organise similar activity in the classroom. In this narrative, we observe elements of Agnes's designated identity (Sfard and Prusak 2005), implying that she wants to become a better mathematics teacher. In the focus-group interview (3rd situation), she says that she has organised "a one lesson workshop" in her own class for each week:

Agnes: All last year [autumn 2004–spring 2005] I had workshops one lesson a week with my sixth graders, and it's clear that this was one of the most exciting things they did at school. ... well but I think that they have learnt to find out things

themselves. They have learnt to proceed tentatively. They have learnt to talk about tasks and we talk about finding solutions and that there are maybe several solutions to a problem too. (FG_060313)

This reflective narrative illustrates how Agnes recalls her experience with workshops one lesson a week in her own classroom throughout the school year 2004–2005. She also reflects on what her pupils might have learnt from this activity, revealing that a crucial component of working on tasks in workshops consists in discussing several possible solutions to a task.

In the focus-group interview, Agnes continues by explaining that in the current school year (autumn 2005–spring 2006), she has organised the workshops differently:

Agnes: We don't have them [the workshops] once a week... but we have them at some regular intervals. But we also have workshops in connection with new topics and subjects in parts of lessons. But last year we had them consistently one lesson a week. But this year they are more integrated [into the lessons]. They [the pupils] think it's very interesting. (FG_060313)

Agnes changed her way of organising workshops in her own classroom, from holding these each week (during the first year of the LCM project) to integrating these workshops into her lessons more naturally, depending on topics and subjects (during the second year of the LCM project). The three reflective narratives demonstrate Agnes's willingness to *transpose*, *implement* and *integrate* workshops in her classroom. This illustrates her actual identity (Sfard and Prusak 2005), suggesting that she is now organising workshops in this manner. It also seems that Agnes expresses her desire to integrate workshops into her lessons in her future teaching, demonstrating her designated identity.

In the fourth situation 1 year later in a small-group discussion in Workshop 16, Agnes's reflective narrative shows a mathematics teacher who is able to develop and expand inquiry approaches to teaching and learning (Jaworski 2006):

Agnes: We have used a number of these tasks which we have been through here [at UiA] and tried and made those as tasks for the classroom. ... it happens that I think we get a good idea [a task], and then I think how we can try and solve it with pupils later, or how we can give the pupils the opportunity to develop it later. ... we have mentioned, how do we manage to avoid this being only a 'happening'. (Ws 16, SG2-070328)

Even though a number of tasks were presented in workshops at the university, Agnes makes a careful selection before trying out a particular task in her own classroom. Even more importantly, Agnes emphasises that mathematics tasks used in a workshop context in a school lesson should be used critically and not as a "happening".

Integrating and expanding models of teaching

Before Agnes joined the LCM project, she was, together with two of her colleagues, concerned with finding approaches to the teaching and learning of mathematics, which would stimulate pupils to wonder and pose questions through investigations and discussions. Based on this prior collaborative work, the teachers designed a model for teaching that they labelled the *Phase Model*. Agnes presented this model for all the participants, present at the last workshop in the LCM project (Ws 16, 070328). Based on Agnes's

plenary presentation (5th situation), we have summarised the model in six phases (Bjuland et al. 2009, pp. 111–112):

1. Exploration and motivation (pupils are encouraged to explore, investigate and conjecture about mathematical ideas while working on problems in small groups);
2. Discussion (pupils discuss ideas emerging from solution processes in dialogue with their teacher—they explain and justify their solutions);
3. Conclusion (teacher and pupils look at other problems that are similar to the problem they have discussed);
4. Lecturing (teacher or pupils present the mathematical content);
5. Practice (pupils work on more tasks in order to appropriate the mathematical subject);
6. Evaluation (teacher proposes different forms of assessment in order to make sure that the pupils have understood the mathematical subject).

This model reveals interesting characteristics of Agnes’s view of teaching. The pupils are challenged, through the first phases (phases 1–3), to be involved in inquiry-based processes that demand a considerable amount of personal agency (Boaler 2002). They are also encouraged to focus on the agency of the mathematical discipline (phases 4–6). So, through the Phase Model, pupils are engaged in a “dance of agency” (Pickering 1995): they shift between personal agency and disciplinary agency in order to make progress in their learning of mathematics.

In the reflective narrative below, selected from the semi-structured focus-group interview, Agnes confirms that the work of designing the Phase Model was started before she entered the LCM project. One of the reasons for Agnes joining the project was her perception of a close connection of ideas related to approaches to learning and teaching of mathematics, between the LCM and the Phase Model:

Agnes: ... we had worked a lot on mathematics and Egil, Fredrik and me, we had designed what we call the Phase Model. ... And then we thought that this [the LCM project] fitted in nicely with what we were concerned with. And [we] thought that this could be a further development for us. (FG_060313)

Agnes expresses that it was her hope that the Phase Model could be developed and expanded through the project. In the same interview, Agnes confirms that being a participant in the LCM project has convinced her that the Phase Model is a good way of approaching the teaching of mathematics:

Agnes: Then I think ... what has been fine, it’s that, in a way, I have had it confirmed that the Phase Model is a good model for thinking and working on [mathematics] ... since we have managed to integrate this closely together with what we have discovered through that work. This is so closely connected with all the investigations we have done at UiA in those tasks we have worked on. So if we manage to integrate this well together among our pupils, then I think that we will manage to achieve a good way of teaching mathematics. Or the pupils will manage to learn much more than we [think]. (FG_060313)

Agnes integrates previous ideas from her practice as a teacher with new ideas emerging in the project. Her conceptions of teaching, made explicit in the Phase Model, are closely connected with ideas and investigations on mathematical tasks presented in the project. Agnes’s plenary presentation in Workshop 16 confirms the relationship between the Phase Model and the LCM project:

Agnes: So this work [related to the Phase Model] we have not learnt this from the project, but what we have done in the project has enhanced the thinking we did. See how much pupils learn when they get the opportunity to try out things themselves when they could explore things [the mathematics]. They would then have quite another foundation compared to if we only tell them what it's like. ... Thanks for all the enhancement, it has been so good to become aware of it. ... Yes, it's important what we are doing! (P-Ws 070328)

The reflective narrative quoted above illustrates Agnes's positioning as a teacher, emphasising the importance of giving pupils the opportunities to engage in a process of personal agency (Boaler 2002). It seems important for her to express that the participation in the project has enhanced her teaching practice related to the Phase Model.

In our analyses so far, we have only been concerned with first-person reflective narratives. We have followed Sfard and Prusak's (2005) emphasis on first-person self-told identities since these narratives may have the most immediate impact on Agnes's actions. We will now introduce a narrative authored by the principal at Agnes's school. In the narrative, Agnes and her two colleagues are the identified persons and the participants in the focus-group interview are the recipients:

Principal: We have to be honest and say that it was you [Agnes and her two colleagues] who were a part of the LCM project, being at workshops, who tried out things in the classroom. ... There was not much work internally at our school. ... We have to do something here, to make a better structure and put this into the system. ... We want all teachers at our school to work in this way. ... The Phase Model should be a standard for how we talk about mathematics and work with this subject. (FG_060313)

We present this reflective narrative since it shows clearly the relevance of the work Agnes and her two colleagues had done at their school with their design of the Phase Model. This was clearly acknowledged by the Principal. As participants in the LCM project, these teachers had also been willing to try out new ideas in their own classroom. According to the Principal, the Phase Model should be extended and used by all teachers at the school. This illustrates Agnes's role as one of the leading teachers. By becoming identified with the ideas of the project, she is now considered by the Principal as a model of identification for other teachers.

Challenging positioning in relation to didacticians

The reflective narrative below (3rd situation) shows how Agnes positions herself in relation to didacticians in the LCM project:

Agnes: ... in the beginning [of the project] I struggled, had a bit of a problem with this because then I thought very much about you coming and telling us how we should run the mathematics teaching. That was what I thought, you are the great teachers. (FG_060313)

Agnes felt a tension, identified at the beginning of the project, between teachers and didacticians related to her presumptions about the different roles of the two groups. The reflective narrative shows Agnes's perception of the asymmetric roles of teachers and didacticians. However, her view changed throughout the project:

Agnes: ... but now I see that my view has gradually changed because I see that you [plural] are participants in this as much as we are, even though you [plural] are the ones organising this. Nevertheless I see that you [plural] are participating and are just as interested as we are in solving tasks on our level and finding possibilities, finding tasks that may be appropriate for the pupils, and that I think is very nice. So I have changed my view during this time. And I think it's much better now, I feel much more comfortable, because now I feel that we are more equal than we were in the beginning, from my point of view. (FG_060313)

The follow-up narrative quoted above from the focus-group interview (3rd situation) illustrates Agnes's development in the project based on reflection, thinking and awareness of her own role in the project. This narrative also illustrates the process of change, from an asymmetric relationship to a closer symmetric relationship with the didacticians. The transformation of roles reveals her identity as dynamic and situated in the LCM community.

The following minimal narrative confirms that Agnes is able to challenge the didacticians, indicating that teachers are more experienced than didacticians in using tasks in the classroom:

Agnes: We find possibilities for how to use the tasks in our classes, and ideas maybe in another way than you [didacticians] have considered. (FG_060313)

The last narrative shows Agnes's reflection about the way to organise groups in the workshops at UiA:

Agnes: What I think has been really good [in the project] that's eh, something has happened in our meetings at UiA too. Since the beginning [of the project] we started to work in mixed groups across grade levels didn't we? But now we have groups for Grades 5–7 and Grades 1–4. ... that I think is really good, since then it concerned me much more when I speak to teachers who have pupils in the same grades, almost the same grades. And that is something you [didacticians] have changed during [the project] (FG_060313)

She states clearly that small-group discussions are more useful for her when teachers cooperate with colleagues who are teaching at the same grade levels. Agnes emphasises the flexibility of the project organisation, indicating that the didacticians have been willing to change their way of organising groups at the workshops from mixed to homogeneous, according to grade level. She is fully aware of her position as a teacher in the project, expressing her perspectives for the improvement of small-group organisation.

Discussion and conclusion

In this study, we characterise some elements of professional teacher identity, emerging from an experienced teacher's imaginative (personal) narratives (Bruner 1986; Burton 1999), which are enacted from the discourses and activities of the LCM project. We have taken a narrative approach to *identity* as used by Sfard and Prusak (2005). We are aware that collections of narratives that we assemble do not constitute all processes, which shape the development of the whole professional identity since such processes continue throughout a teacher's professional life. However, in the scope of this study, we have been concerned with reflective narratives from different situations occurring over a 2-year

period. Unlike Sfard and Prusak (2005, p. 20) who “talk *about* what students said rather than reproducing their exact words”, we have based our analyses on what Agnes actually said in different situations. In these narratives, we observed elements of her *actual identity* in which she reflects on her teaching and activities related to the project. We also found sign of Agnes’s *designated identity*, implying that she wants to improve her work in order to become a better mathematics teacher.

In the present study, the analyses have suggested the pertinence of four identity indicators, emerging from both the actions and the reflective narratives of the teacher. The first identity indicator, *positioning in relation to pupils*, has been constructed and labelled from the analyses of a cluster of three reflective narratives and supplemented by observations of Agnes in action with her sixth-grade pupils within a period of 2 years in the project. Agnes’s roles of *presenter*, *supervisor* and *coordinator* illustrated how she positioned herself in relation to her pupils while working on the diagram task in the classroom. Positioning can also be related to Agnes’s sensitivity to the difficulties pupils experience in their solution processes, and further her reflection on analysing the diagram task based both on her own experience with the task and on the pupils’ performance.

The second identity indicator, *reflecting on developing a workshop model in teaching*, was located to three reflective narratives in the analyses. These showed Agnes’s willingness to *transpose*, *implement* and *integrate* workshops in her classroom. We might debate whether this development of organising workshops in one’s own class is an indicator of professional teacher identity. Agnes is inspired to try out ideas from the project workshops at the university in her own classroom (first narrative). She has organised workshops one lesson a week (second narrative) and has developed the workshops so that they are integrated more naturally into her lessons (third narrative). It could be argued that these three reflective narratives show signs of professional identity, which is related to inquiry processes and critical alignment with the LCM project (Bjuland and Jaworski 2009). However, we see the need for further evidence before claiming that her way of changing her teaching practice from organising isolated workshops once a week to integrating workshops more naturally in the lessons is an indicator of professional identity development in her teaching practice. The fourth reflective narrative, selected from a small-group discussion (4th situation), shows promising signs of professional identity since Agnes is here reflecting on the importance of making careful and critical selections of mathematical tasks to be used in a workshop context. We suggest that Agnes’s reflection 1 year later in the project makes the cluster of reflective narratives more convincing for our construction of the identity indicator.

In addition to reflective narratives told by Agnes where she expresses that participation in the LCM project has enhanced her teaching practice related to the Phase Model, the third identity indicator, *integrating and expanding models of teaching*, was supplemented by a narrative given by the Principal of Agnes’s school. This narrative is compelling, as it is authored by a person of authority with respect to Agnes’s professional identity. Perhaps this narrative warrants further attention in regard to its significance in illustrating how Agnes is recognised within the school community. The cluster of reflective narratives has revealed Agnes’s *competence*, *performance* and *recognition* as a mathematics teacher, illustrating important dimensions of professional teacher identity (Carlone and Johnson 2007). We therefore suggest that the third identity indicator illustrates evidence of Agnes’s professional identity as a primary mathematics teacher. Agnes’s development of the Phase Model highlights her position as ‘co-researcher’, reflecting explicitly on her professional teacher identity.

The cluster of four reflective narratives, told by Agnes to participants in the focus-group interview (third situation), has been constructed and labelled as the fourth identity indicator, *challenging positioning in relation to didacticians*. The fact that Agnes has changed

her positioning in relation to didacticians from the first to the second year of the project illustrates Agnes's professional identity in the context of the project. We are aware that the other identity indicators have been constructed from reflective narratives obtained from more than one situation in order to capture professional teacher identity. It could then be argued that this fourth identity indicator is not so convincing. However, Agnes's plenary presentation at Workshop 16 about 1 year later in the project (March 2007) also illustrates the closer symmetric relationship that had been established among participants in the project.

Our analyses have located four identity indicators, all related to Agnes's participation in the LCM project. More specifically, the analyses have revealed how a primary teacher's reflective narratives give evidence of professional identity in a continuing and dynamic process shaped by multiple engagements in different didactical activities. Agnes has participated in a community of inquiry, and she has been critically aligned with practices in that community (Bjuland and Jaworski 2009). Her reflective narratives have illustrated a particular teacher who has been engaged in collaborative inquiry processes with other teachers and didacticians in the project, reflecting on what has been achieved and introducing new aspects for critical consideration.

It is important to emphasise that, in our work, we have not attempted to attribute a particular professional teacher identity to Agnes, trying to fit our data to a specific model. Instead, we have investigated indicators of identity emerging from reflective narratives in different contextual situations. Inspired by Sfard and Prusak (2005), we have focused on first-person self-told narratives related to Agnes's actions. According to Ponte and Chapman (2008), a crucial aspect of a teacher's professional identity is his or her participation in the processes of reflecting, interacting and collaborating with other teachers. In accordance with these authors, we suggest that the four identity indicators illustrate crucial aspects of Agnes's identity as an experienced teacher.

Are we able to see any development in Agnes's professional identity based on our data? Research highlights that the situated nature of mathematics knowledge in teaching can be conceived of as a process of professional identity change (Stein et al. 1998; Hodgen 2011). In our work, this question is of course difficult to answer given the limited information in the project data. However, our analyses have shown three examples that may indicate some identity development. One example is Agnes's way of developing the idea of a workshop by *transposing*, *implementing* and *integrating* this model into her own teaching practice. Another example is Agnes's earlier activity in designing the Phase Model, and then integrating new ideas that emerge from participating in the LCM. In this way, it seems as whether the project has functioned as a catalyst for Agnes's thinking. A third example suggests that Agnes has changed her positioning in relation to didacticians, from having an asymmetric relationship in the beginning of the project to having a closer symmetric relationship throughout the project. We are aware that the three examples, emerging from the identity indicators, illustrate only a brief glimpse of such development.

After having analysed these reflective narratives told by one teacher, we now ask ourselves whether this approach may be an appropriate research methodology to provide evidence of professional teacher identity. There is a danger that a teacher such as Agnes may present herself to other participants in the project in the way that she wishes to be seen and heard. This is a serious issue that we need to take into consideration when we construct accounts of identity from narratives. In order to approach this problematic issue, we have chosen reflective narratives over a period of 2 years, focusing on particular ones that reveal Agnes's critical thinking, reflection and awareness. We claim that the identification of these reflective narratives, which are related to theoretical constructs such as inquiry

community and critical alignment, makes an important contribution to the understanding of professional teacher identity. Our claim is also supported by Hodgen's (2011) focus on the notions of story and narrative in the context of teachers' professional identities in order to rework and restructure teacher knowledge.

To be more explicit, we have used Labov's (1972) idea of minimal narrative to deal with the teacher's reflections, providing in this way a method that might be seen as valid for analytical purposes. In our analysis we have not "seen" evidence of teacher identity from only one single turn. Instead, reflective narratives have been clustered in order to construct the four identity indicators. In further studies, there is a need to develop constraints and rules for reading identity from narratives.

One may ask what the importance is of learning about the constitution of a teacher's professional identity through reflective narratives. From Ponte and Chapman's (2008) review of studies that were carried out in promoting the development of prospective teachers' identity, we have learnt that reflection on practice and investigating practice are two main research themes that could play important roles in fostering professional identity development. Another study (Hodgen and Askew 2007) revealed how a particular primary teacher became engaged in mathematics despite initial avoidance of the subject. We suggest that the construction of clusters of reflective narratives expressed by a primary teacher in order to detect indicators of professional identity could make an important contribution for learning more about the professional development of a teacher.

One crucial pedagogical feature emerging from our work is the value of generating discussions about professional teacher identity in courses at teacher education colleges, and also in professional development courses for experienced teachers. From this perspective, it is important to focus on identity not as a fixed position but as being continuously in a process of transformation through contextual activities, reflections and personal internalised experiences.

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