

## **Teacher noticing as a growth indicator for mathematics teacher development**

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In this paper, we report on our analysis of four transcripts of teacher meetings that took place over the academic year 2011-12. These meetings took place in the context of a project looking into tackling underachievement in primary mathematics through a focus on creativity. We bring the idea of growth indicators (Jacobs, Lamb and Philipp 2010) within the framework of noticing (Mason 2002) in order to analyse shifts in teacher discourse. There is evidence of growth but we conclude by discussing the complexity of teacher change and problems with any set of indicators.

**Key words: noticing, primary school teachers, mathematics teacher development, growth indicators.**

### **Background**

In this paper we report on our analysis of four transcripts of teacher meetings that took place over the academic year 2011-12, in the context of a project aimed at tackling underachievement in primary mathematics through creativity. The project is a collaboration between the University of Bristol and the charity '5x5x5=creativity' (5x5x5), it is funded over the period September 2011 to July 2013, in part by the Rayne Foundation. For the purposes of the project, we were defining creativity within mathematics to be indicated by students noticing patterns, asking their own questions, making their own conjectures. In the first year, which we report on here, three primary/infant schools in the South West region of the UK were involved. One teacher from each of the three schools joined a project group that met five times over the academic year. These were twilight meetings that generally lasted just over an hour. Alf convened this group and, in between meetings, was able to visit the schools to observe and then lead sessions with the teachers' classes, with a focus on running activities and class discussion in a way that allowed and supported student creativity. Alf made on average 10 visits to each school. The focus of the meetings was on teachers sharing the work they had been doing, including strategies for developing creativity and for tackling underachievement. The ages of the focus classrooms were year 2 (aged 6-7) in schools A and B and a mixed year 3-4 in school C.

### **Theoretical Framework**

Noticing is an important skill for teachers. However, noticing effectively is challenging. Although this skill has been conceptualized from different perspectives, the common theme is how teachers process complex classroom events. Mason (2002) considered noticing to be a fundamental element of expertise in teaching, characterized by: (a) keeping and using a record, (b) developing sensitivities, (c) recognizing choices, (d) preparing to notice at the right moment and, (e) validating with others. On the other hand, van Es and Sherin (2002) considered that noticing includes: (a) identifying noteworthy aspects of a classroom situation, (b) using knowledge about the context to reason about classroom interactions, and (c) making

connections between specific classroom events and broader principles of teaching and learning.

Recent studies have provided different contexts for the development of the skill of noticing. For example, Coles (2012) proposed aspects within his role of facilitating discussion of teaching videos. One of these aspects is moving to interpretation: during a period of time constructing ‘accounts of’ (Mason 2002) what was observed on a video clip, the task is to reconstruct the precise words or actions and their chronology. In focusing on the detail of what was noticed or observed, it is possible to then move to accounts *for* (interpretations of what occurred and why) avoiding judgmental comments. Noticing is supported by having a period of time describing the episode in all its detail and re-watching the clip when needed.

In this research, we are going to select a particular focus for noticing: children’s mathematical thinking. In this context, Jacobs, Lamb and Philipp (2010) conceptualize teachers’ competence in noticing as a set of three interrelated skills: attending to children’s strategies, interpreting children’s understanding and deciding how to respond on the basis of children’s understanding. Their findings also indicated that this skill could be developed, providing growth indicators that can help professional developers identify and celebrate shifts in teachers’ professional noticing of children’s mathematical thinking. Specifically (ibid, 196 (numbering added)),

1. A shift from general strategy descriptions to descriptions that include the mathematically important details.
2. A shift from general comments about teaching and learning to comments specifically addressing the children’s understanding.
3. A shift from overgeneralizing children’s understandings to carefully linking interpretations to specific details of the situation.
4. A shift from considering children only as a group to considering individual children, both in terms of their understandings and what follow-up problems will extend those understandings.
5. A shift from reasoning about next steps in the abstract to reasoning that includes consideration of children’s existing understandings and anticipation of their future strategies.
6. A shift from providing suggestions for next problems in general terms to specific problems with careful attention to number selection.

For the purposes of this paper, we focus on the first four indicators as the last two are linked to instructional decisions. In the meetings that we analyse, teachers are reflecting on their work with their classes and so did not talk about ‘future strategies’ or ‘next problems’.

A teacher gives a general strategy description when he/she identifies a tool or mentions that the problem was solved successfully but omits details of how the problem was solved (indicator 1). If, later on, for example thinking about whole-number operations, the same teacher comments how children counted, used tools or drawings to represent quantities, or decomposed numbers to make them easier to manipulate, we would see a shift into the consideration of ‘mathematically important detail’ (indicator 1). Teachers may give general comments about teaching and learning, such as, “I learned that it’s important to allow students to use different tools to come up with mathematical problem solution” (Jacobs, Lamb and Philipp 2010, 186). If, afterwards, they make sense of the details of a student strategy and note how these details reflected what the children did understand, for example recognizing the ability to count by 2s or the ability to switch between counting by 2s and 1s we could

identify a shift into giving comments specifically addressing the children's understanding (indicator 2). A teacher overgeneralizes children's understandings when they go beyond the evidence provided. For instance, saying, "children understand subtraction and addition — and which to choose when presented with a problem..." (ibid, 186). This broad conclusion is difficult to justify on the basis of the children's performance on a single problem for which many may have used different strategies. If, later on, teachers make sense of the details of a student strategy and note how these details reflected what the children did understand in specific situations, we would said that there is a shift into linking interpretations to specific details of the situation (indicator 3). Finally, considering children as a group is another characteristic of overgeneralising children's understanding; a shift is indicated by discussion of anything linked to individual understanding (indicator 4).

Recently, research has shown evidence of prospective teachers' professional noticing of children's mathematical thinking development in relation to the framework above. Fernández, Llinares and Valls (2012) show that participation in on-line debates supports this development in the specific domain of proportional reasoning. Text produced by prospective teachers in on-line debates helped some of the teachers attend to the mathematical elements of proportional and non-proportional situations and link these elements with characteristics of students' understandings. In Fernández, Llinares, and Valls (2012) there was evidence of such shifts from general strategy descriptions (before the participation in the on-line debate) to descriptions that included the mathematically important details (after the participation). However, more studies, focusing on the different contexts that could improve this skill, are needed. Our objective in this paper is to analyze the discussions of in-service primary school teachers who participated in the project introduced above. We were interested to see if there was evidence of any shifts in relation to the first four indicators.

## **Data and analysis**

In this research we are going to focus on two of the three in-service teachers: Sara and Anna (pseudonyms). They are in-service teachers for the schools A and B, respectively. School A is a rural primary school with high levels of mobility in the student population. School B is an infant school in an urban area with high levels of social deprivation. We have not considered the third teacher involved in the study or school C, since in that school the teacher who was involved was swapped half way through the year, so neither teacher was involved for the whole year.

The data we consider in this paper is the transcripts of the four meetings between staff that were audiotaped. The first teacher meeting was not audio-recorded to allow for an ethical discussion. Other data from the project that we have not analysed includes lesson field notes and students' work. For the analysis we three researchers analysed individually the transcript of the first meeting looking for evidence of the aforementioned shifts (Jacobs, Lamb and Philipp 2010). Then, agreements and disagreements were discussed in an attempt to share the evidence for shifts. Once we shared this evidence and came to an agreement, we applied these filters to the rest of the meeting data.

## **Results**

In this section, we present some evidence of the shifts in the two in-service teachers, Sara and Anna. We begin by offering two sections of Sara talking, which were chosen

as they were the first comments she offered, in responding to the invitation to reflect on the work she had been doing in her classroom.

**Sara (meeting 2)**

*The first session, we looked at the place-value chart didn't we before the last meeting and I talked with Alf about some of my children used to work with decimals. And also to consolidate multiplying and dividing by 10s, 100s and 1000s and in the first session we looked at the chart and noticed patterns and then they had to make a journey, how could they get, going up and down the columns and choose a number and take a journey and get back to the same place, and so they could do a journey of two steps, they might take five multiply by ten and divide by ten to get back, they could try and take it further. By the end of that session some of them were getting more adventurous because we'd shown them decimals on the other side of the chart.*

**Sara (meeting 3)**

*This is M's from last year, he did similar kind of activities where they revisited their work cut it out and made comments... Today they started with shapes. It's the investigation of how many sticks are you using. So he started to comment about what he noticed and how he felt. So looking at what the answers were and just showing he found it quite there and he found it easy but he's got all this other work about patterns.*

We observe that there is a shift across these meetings from considering children only as a group in meeting 2, to considering individual children in meeting 3 (indicator 4). Some evidence of this shift is when she says, in meeting 2, “*they could do a journey*”, “*some of them were getting more adventurous*”. Later on, in meeting 3, she considers individual children, for example, she talks about the work of “M”. We also see a shift from general comments about teaching and learning to comments specifically addressing the children’s understanding (indicator 2). In meeting 2, Sara says “*we looked at the place-value chart... to consolidate multiplying and dividing by 10s, 100s and 1000s*” “*they could do a journey of two steps*” (general teaching and learning comments). In meeting 3, she says “*he started to comment about he noticed and how he felt.... He's got all this other work about patterns*” (she has addressed the child’s understanding). In contrast, we do not see a shift in indicator 4 (from overgeneralizing children’s understandings to carefully linking interpretations to specific details of the situation). An example of generalizing children’s understandings in meeting 3 is when she says, “*So looking at what the answers were and just showing he found it quite [ ] there and he found it easy but he's got all this other work about patterns*”. Although she has addressed the child’s understanding, she goes beyond the evidence provided: “*he found it easy but he's got all this other work about patterns*” (what Jacobs, Lamb and Philipp (2010) called limited evidence of interpretation of children’s understanding). We see, across the two transcripts, general strategy descriptions without mathematically important details (indicator 1).

In the next transcripts, focusing on Anna in meetings 2 and 3, we observe that she talks on both occasions about individual children (indicator 4), this was a general pattern across all meetings. In meeting 2 she talks about “M’s” progress and in meeting 3, she continues talking about this child, we have selected these excerpts below for analysis, to see what has changed in how she talks about the same child.

**Anna (meeting 2)**

*So, we've got this boy who actually I don't know if you remember M on the first session and he sat one of the first times when you came in when he copied and he sat next to A who records really neatly. He didn't know what was going on but he copied how she recorded as in one number in each box. So, I was he's copied, he hasn't done anything. But actually from that he's recording his own and recording in that way which is really nice. So here it was, they could each choose, they chose their own number and practicing how many different ways they could make that number using the Cuisenaire, so he picked up the yellow. So we worked out what number that was and it was 'five'. So, then he started building his five wall and recording it and for him this is amazing. So, he is knowing that it all equals five. He is beginning to see well he's adding them together even though it's not in the 1 plus 2 plus 3.*

**Anna (meeting 3)**

*And then M. He tried this with Cuisenaire and realized he couldn't really work it out so he moved onto a hundred square when he was doing his finding out about the five times table and so then spotted the pattern that he is going and circling on the hundred square, so he could just carry it on. And that was the first step in January of him being able to notice a pattern that he could then use.*

Anna has given comments addressing the children's understanding, and does not give general comments about teaching and learning (indicator 2). For example, in meeting 2, she says "*he picked up the yellow. So we worked out what number that was and it was 'five'. So, then he started building his five wall and recording it...he's adding them together even though it's not in the 1 plus 2 plus 3*". And in meeting 3, she says, "*he tried this with Cuisenaire and realized he couldn't really work it out so he moved onto a hundred square when he was doing his finding out about the five times table and so then spotted the pattern that he is going and circling on the hundred square*". However we can observe a shift from overgeneralizing children's understanding in meeting 2 to linking interpretation to specific details of the situation in meeting 3 (indicator 3). The evidence is that in meeting 2 she says "*So, he is knowing that it all equals five. He is beginning to see well he's adding them together even though it's not in the 1 plus 2 plus 3*". Although there is attention paid here to the children's understanding, we read an overgeneralisation in the comment "*he is beginning to see well he's adding*", which we do not read as something it is possible to observe directly. In meeting 3, she says "*And that was the first step in January of him being able to notice a pattern that he could then use*". Here, in contrast to meeting 2, the comment is a careful interpretation of specific details – M has noticed a pattern that he was able to continue and this was the first time he had done this during the year. In these two contrasting comments we see evidence of Anna considering mathematically important details in both (indicator 1) although perhaps, as ever, there are more mathematical issues that could be raised.

## **Discussion**

At the BSRLM session in Cambridge we valued highly the comments we received from participants at our session, where we asked people to use the framework of growth indicators to analyse the transcripts above. The analysis above has been

informed by the discussion. However, in offering these transcripts we also wanted to raise questions about the growth indicators themselves and this also came out of the discussion at BSRLM. One participant pointed to a phrase of Anna's from the second meeting, that was not particularly relevant to the growth indicators, but which he felt was strong evidence for change. Anna says, "So I was he's copied, he hasn't done anything. But actually from that he's recording his own and recording in that way which is really nice." In these comments, Anna is demonstrating an awareness of her own learning. She is noticing that her ideas altered about the value of this student copying a recording method from another student. This kind of noticing is not part of the framework of growth indicators and yet, for the participant in the session, is a key feature of teacher growth.

In the session we also discussed some underlying assumptions behind the whole notion of 'growth'. The word perhaps carries implications of a linear or uni-directional movement or some kind of ideal endpoint. In contrast, we bring to mind a phrase of a 5x5x5 artist, Catherine Lamont who, when talking about positive changes in some students in the context of her own work, stopped herself and commented: "it's not even a move forward, it's a move." In the transcripts of Sara and Anna, above, we also see evidence of 'moves' without necessarily wanting to invoke a direction or value judgment.

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