

## Teacher Beliefs, Teacher Practice and Learner Learning: A Case Study

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Conflicts between mathematics teachers' beliefs and the reality of their classroom practice have been widely reported in the literature (e.g. Cooney, 1985; Newstead, 1997). In many cases teachers express beliefs about the learning and teaching of mathematics which do not translate into their classroom practice. There can be various reasons for this lack of consistency, including conflict with the school's culture or with the expectations of students about what constitutes mathematics and how it should be taught (Cooney, 1985). It can, in fact, be questioned whether 'beliefs' expressed in isolation outside the classroom have any relevance, or whether beliefs can only be observed as *situated* in the classroom practice (Hoyles, 1992).

Many teachers have enthusiastically taken on the current discourse related to changes in the South African curriculum. It is easy to be persuaded that 'group work' is the way forward in mathematics education and that if learners can no longer be failed, we as teachers must address their individual needs by diagnosing and differentiating so that the *outcome* (but not in all cases the input) is the same. In reality, however, these principles are difficult to implement. This paper reports on an attempt to support the implementation of exactly these two aspects of MALATI's own beliefs in a particular teacher's classroom. In spite of intensive teacher development and support, the changes which took place in this classroom probably did not lead to a significant improvement in learning.

### Context

The MALATI project involves curriculum development, teacher development and research. Using our own materials as a vehicle, we work closely with teachers at workshops and in the classroom to establish our envisaged classroom culture. In the MALATI vision, learners take responsibility for their own learning, and learn by (via) problem solving (Hiebert *et al.*, 1996). In the process of discussing their solution strategies, errors are identified and progression is encouraged towards more sophisticated strategies. Teachers are encouraged to try to understand learners' understandings in order to constantly plan and adapt their teaching accordingly. One powerful tool which can help teachers to do this is diagnostic analysis of assessment results.

Several recommendations exist in the literature for achieving such change in the classroom. For example, researchers agree that significant change cannot be achieved without the opportunity for teacher reflection and without sufficient support for the teacher (e.g. Etchberger & Shaw, 1992). An important aspect of the MALATI teacher development strategy is therefore that reflection sessions are arranged and facilitated between the mathematics teachers at each school. These meetings are not simply administrative, but encourage teachers to reflect on their experiences in the classroom and on their teaching and assessment practices. For example, such a discussion may address strategies for encouraging participation from all learners in a class. The MALATI teacher development model also includes afternoon workshops (covering both content and classroom culture issues), learner materials with teacher

notes, and classroom support. In the process of visiting each teacher's classroom, MALATI project workers discuss various aspects of teaching and learning with the teacher, and draw his/her attention to misconceptions and other important aspects of the learners' work. They enter into discussion about important decisions such as when individual effort is more appropriate than group effort and when homogeneous groups may be needed to remediate a particular conceptual problem. They also model various aspects of the teaching approach, for example the facilitation of a whole-class report-back at the end of the lesson. MALATI also facilitates 'visiting and reflecting', in which teachers visit their colleagues to observe and then discuss this in a reflection session.

MALATI is conducting research to determine its impact on learners and teachers in order to formulate a 'workable' model of teacher and curriculum development. We are researching whether or not the current model which is being trialled in 7 Western Cape schools, has any significant effect on teachers' beliefs and classroom practice (and, in an additional study, on learners' achievement). To monitor the process of change in teachers, information on the practice and beliefs of Grade 6 to 9 teachers in four of our project schools is being collected as follows:

- Each teacher completed an extensive teacher beliefs questionnaire in November 1997 and will complete this questionnaire again in November 1998.
- The MALATI project worker co-ordinating the teacher development at each school collects extensive field notes on reflections, discussions and critical incidents concerning each teacher during the year.
- At three points during the school year, namely February, July and October/November, two MALATI project workers 'zoom in' on the teachers by visiting them for two consecutive mathematics lessons. During these visits, the mathematics lessons are videotaped. Immediately following the second mathematics lesson, the teacher is interviewed about his/her beliefs and practice, both general and specific to the two lessons observed. A report is compiled based on the visits and the interview, at each of the three points in the year.

### Mr Johnson

Mr Johnson is a Grade 6 teacher with at least 10 years' experience in teaching mathematics at both secondary and primary school level, and a keen interest in mathematics. This paper is a case study based on the information collected about him according to the research methodology described above.

At the beginning of the year, Mr Johnson's class was visited by project workers. It was observed to be a good example of the 'explain-practice-memorise' paradigm (for example Hiebert, 1984), and therefore not in line with the underlying philosophy or envisaged classroom culture of MALATI. Desks for the 24 learners were arranged in rows, with two learners at each desk, and desks placed one behind the other. Mr Johnson began the lesson with a demonstration of rules for carrying out operations with decimal fractions, after which learners completed exercises from a textbook individually at their desks, using only the method that he had explained. Communication between learners was not allowed, and explanation of their thinking was not required. The teacher spent some time sitting with individuals explaining the method again. Although he said afterwards that the lesson was about "fractions in everyday life", no such context was addressed.

### Working in groups: Sharing, discussing, challenging

The MALATI project workers have helped teachers to encourage learners to work in (usually heterogeneous) groups, particularly whenever they are addressing a new and difficult concept in order that they can discuss and debate their various strategies. Peers are seen as an important source of error identification, and discussion as an important way of addressing misconceptions. Teachers are encouraged to facilitate the group work in such a way that all learners solve the problem and participate in the discussion, challenging with respect and listening actively.

Although there was no evidence of group work in his classroom until May, in both his interviews<sup>1</sup>, Mr Johnson expressed his belief that learners should work in mixed groups but that they should choose their own groups, “look for each other...where they work the best”<sup>2</sup>. His reasons for heterogeneous groups were mostly social – that the quicker learner “does not get selfish”, and that the weaker learner has the opportunity to overcome his fear and shyness by talking to a peer. It seems that Mr Johnson had not reflected on the consequences of group work for learning, although he said in July that “Now we have groups in which solutions come quicker...and they talk to each other – communication”.

In May, after observing and being observed by two of his colleagues who were relatively comfortable with teaching in groups, Mr Johnson made some important changes in his classroom. He immediately reorganised the desks in his class into groups and seemed to spend more time moving from group to group than he had previously spent with the learners. One of the other teachers had told Mr Johnson that he “talks too much” and although he laughed about this, he claimed to have “got the message”. He also claimed to have ‘understood’ group work for the first time having observed these two teachers. However, he still did not facilitate any discussion in the groups, simply telling them to “read and discuss”. Although he felt that the work was “getting done”, MALATI project workers observed that learners, being left to “carry on with their MALATI projects” were not completing their activities and were omitting many questions that required reading and understanding. In addition, the learners were confused by conflicting messages from Mr Johnson instructing them alternately to “talk and discuss” and “be quiet, what’s the matter with you?”

MALATI project workers have demonstrated and modeled to Mr Johnson on several occasions how to facilitate a whole-class report-back discussion such that learners can be exposed to a variety of methods and so be encouraged to develop more sophisticated and mathematically formal methods. Mr Johnson himself claimed in his July interview that he regarded the report-back as very important so that “the other group can see what this group thought...each group has different opinions, sometimes they are the same but different ways”. However, he has never been observed to facilitate such a discussion unless specifically requested to do so. Even on these occasions, he chose to facilitate report-back on questions on which all the groups agreed and said that part of his motivation for the feedback was because “they were taking very long, that’s why I felt that they must finish and I had feedback”. It is therefore not clear whether Mr Johnson understands the purpose of this discussion.

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<sup>1</sup> This paper refers to the first two interviews conducted in 1998, in February and July.

<sup>2</sup> The interviews were conducted in Afrikaans. Extracts have been translated into English for the purposes of this paper.

### Continuous diagnostic assessment: Together and apart

An important aspect of the MALATI philosophy is that the teacher's knowledge of what the learners know and can do should be the most important tool in the planning of a mathematics lesson and that the teacher should constantly adapt according to this knowledge.

In the first place, this has implications for assessment. MALATI has helped teachers to create diagnostic profiles of individual learners based on tests, exams and even ordinary class activities. Based on these observations and profiles, suggestions are made concerning the temporary regrouping of learners with some learners working with the teacher in a homogeneous group addressing a particular concept. At the point where the teachers judge all the learners' concepts as adequate, the learners are regrouped into heterogeneous groups to continue. We refer to this as TAP (Together and Apart) (Linchevski *et al.*, 1998).

In May, a workshop was held with Mr Johnson and his colleagues to help the teachers to become more familiar with such diagnostic assessment. Fractions tests from his school were used to demonstrate how such an assessment can be used to draw up a grid showing profiles for each individual child (and in the process to assess the assessment instrument itself question by question). A discussion was held on how the resulting profiles can be used for the planning of further teaching.

In August, a MALATI project worker worked closely with Mr Johnson on selecting and diagnostically analysing an activity which had been individually completed by the learners, with the aim to identify learners who were having conceptual problems with fractions. Although he claimed to "agree" and to be excited by "how easy it was" he did not take any further action regarding the learners who were identified as having problems.

However, Mr Johnson's beliefs seemed very much in line with our philosophy in this regard. He said that it was not the case that "the child fails and that's finished" but rather that he "gives him a chance that he can catch up to the child who works quicker...the continuous evaluation system, because there is more elasticity in the...process". In both interviews, he referred to a system whereby he has 'in the past' kept a record of problem areas in learners' understandings, but was unable to elaborate how he would use this other than to say vaguely, "group them, try to work on them" and "I can even show the parents as well".

Mr Johnson emphasised in both interviews, that "differentiation" and "identification of the different levels" are important, and that this is possible even in large classes by "taking a sample". However, also in this regard, there was no evidence of implementation in the classroom. He claimed to consider his weaker child when planning the lesson, and declared that "...the old way of teaching mathematics, and then accepting that the child knows it, is over...I will not stop until I know that (the weak learner) understands...". However, in the lessons that we observed throughout the year, Mr Johnson took answers only from the learners who raised their hands in response to leading questions and ignored incorrect responses. There was thus no evidence of efforts at identification of different levels of existing knowledge. As far as differentiation is concerned, he explained that he does not believe in giving different learners different activities ("I feel that they must all be on the same level"), except maybe in the case of the 'stronger' learners, in which case he would only give a little

“extra exercise”. He seemed concerned that the weaker learners would develop “complexes” if differentiation takes place. MALATI project workers observed that although learners (even within the same group) were often busy with different activities, this was through their own individual choice and not an effort at differentiation by Mr Johnson.

This aspect of the MALATI philosophy also implies that the teacher should constantly be focused on what learners are doing and saying during any lesson and particularly on their errors, and should be prepared to adapt their lesson appropriately. In February, Mr Johnson said that he often deviated from the planned lesson when he realised that there were children who did not understand the “basic thing”...so “your preparation for your lesson for the day...is not necessarily the lesson that you give. It is never the lesson that you give”. He claims that in such circumstances, he designs “something which is very elementary”. Interestingly enough, in response to the same question in July, he said, “I have not come across such a situation”. Mr Johnson has only been observed to adapt his lesson and deviate from his planned lesson in the case of explaining a ‘real-life’ context or a “moral lesson”.

Within the MALATI framework, deep-rooted misconceptions are considered to be ‘valid’ rather than careless, and can thus not be eliminated by the teacher simply repeating his/her explanation or reprimanding the learners. Mr Johnson’s reaction to errors changed significantly in this regard during the year. At the beginning of the year, Mr Johnson constantly blamed his learners’ errors and misconceptions on disciplinary factors. When asked in February what he would do in the case of errors, he said, “call him in. Or I would go and sit with him...say ‘move up’...or I would call him to my table, but...I don’t really like the table-story. I always like to go and sit with them. And then I take their pencil and I start to work there. Then they feel good because then...because I am with them...I would explain to them again...step by step...show him the way which I am busy with...I would start from the beginning again with him”. When asked the same question in July, he replied vaguely “I don’t think it’s wrong. Those mistakes must happen...(I react) positively, very positively” Asked what he would actually do, he said “talk to him, try to point out to him there’s another method, or you can try it like this, or talk to your friends...”.

However, MALATI project workers observed that he was often not aware of such errors and misconceptions; In many cases learners’ books were marked with ticks whether or not their solutions were correct, and this tendency did not change as the year progressed<sup>3</sup>. In both interviews, Mr Johnson’s recollection of occurrences during the most recent lessons was poor, and his articulation of the goals with the lessons was vague. It seemed that he himself had not come to grips with the content of the lessons and was unable to reflect on the purpose of the activities, saying things like “I was just glad that they could work together”. When confronted with a specific error which occurred in his class (in July), Mr Johnson could not remember the error or his reaction. He said “I think I probably talked or something else...or I led them, I can’t remember any more”.

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<sup>3</sup> The school culture may have contributed to this in that teachers are required to demonstrate regularly that they have ‘marked’ the books with red ink!

### Reflecting on the Change in Mr Johnson

In June, Mr Johnson described his own process of change during the first 6 months: "I am starting to see things in a different way to what we did in the beginning – you know how we struggled, new concepts, a new approach, MALATI a new name, etc...I also had to go through that point, the bridging phase, but I think I am on the way now....it is almost as if you had a method, you couldn't see beyond that method, almost like tunnel vision". Although this is a very positive reflection, we were concerned that he added vaguely: "But now I have a more extended form of approaches, and that is the whole idea, that the child must, he must discover". One positive change that we observed in Mr Johnson, was also mentioned by him in July: He said that "now that the children are in groups, I am much more involved, than when I looked at the class globally as one person. Now I move between the groups...and I see what (each child) is doing, how they approach things...I have more contact with my learners...I no longer write a sum on the board...like I did in the beginning...I don't write a method on the board, you must discover the method or try to understand the sum, or discuss how you are going to attempt the sum". Once again, however, we were concerned about his vague reference to 'discovery' and by the implications that this holds for his own beliefs about the nature of mathematics. According to Mr Johnson, these changes have "overflowed" into other subjects in the sense that these subjects are now less "rigid" and the learners are now expected to "discover" and to do "research" and "find their own knowledge" in the library.

This interpretation of 'discovery' is very different to our belief that children should *and do* construct their own knowledge in the context of solving problems and discussing their strategies with their peers. In his definition of his role as a mathematics teacher, Mr Johnson changed from seeing himself as being "very dynamic in the sense that I can pass (knowledge) on" (February) to "...more facilitator, that is the term which is beginning to catch on with the teachers nowadays" (July) but added "in the sense that we must be more of a facilitator in the sense that we must lead the child...he must go through his discovery phase, I must just be there to lead the child to different levels of different things in the mathematics...I don't give the solutions to him, I give an idea which he can work on to find the solution". In both interviews, he mentioned 'leading' the learners several times, in February emphasising "step by step" and in July speaking of leading the child to "...that which you must complete and what he must discover etc." Beyond this, he was extremely vague about his goals, speaking of "promoting the culture of love of mathematics" and helping learners to discover the "warmth of mathematics". In July, he reflected on his previous classroom practice: "I don't want to be a teacher like my teacher was in mathematics...he was a terrible guy, but in fact I always showed those symptoms which he had in the class".

In theory, Mr Johnson fulfilled several of the prerequisites which have been cited (for example, Etchberger & Shaw, 1992) as necessary for change to occur: At the beginning of the year, he expressed to us his dissatisfaction with his learners' performance in the past, he enthusiastically and continuously welcomed all change and 'help', and his beliefs as expressed in the interviews showed that he was envisioning what the change would actually involve. He experienced the discussion opportunities with his colleagues as positive: "We started to talk to each other, the teachers themselves, which never happened...we were on our own, we were an island":

During the course of the year, opportunities were provided for extensive reflection on classroom practice, materials were provided which by their very nature should have helped to facilitate change, a supportive professional development environment was provided by MALATI, and the school as a whole gave its complete support. In spite of all these factors, and in spite of Mr Johnson's beliefs expressed in the interviews, the transformation in Mr Johnson's classroom can be regarded as largely superficial. He has stopped verbally blaming the learners' errors on the learners' behavioural problems and is spending more time with his learners. He has grouped his learners although there is little evidence of group work, and he has stopped demonstrating methods and rules on the blackboard. Although he shares in the discourse about identifying different levels and differentiating, he does not appear to adapt his teaching in any way according to evidence of learners' knowledge exposed by their responses in their classroom or obtained from diagnostic assessment. At this point, the feeling of the MALATI project workers is that this change is not significant enough to lead to improved learning, although data on the learners' achievement will only be collected in November 1998.

Perhaps there was not a sufficient commitment to change on the part of Mr Johnson, or perhaps sufficient time has not been allowed thus far. Mr Johnson's language, his description of his theory regarding some crucial aspects of teaching and learning, did change during the year, but his classroom practice regarding these aspects did not change significantly. In February, however, there was already little connection between his theory as expressed in the interview and his practice in the classroom. Perhaps it is only sensible to speak of beliefs-in-practice, and in this case Mr Johnson's beliefs are situated (Hoyles, 1992) in the classroom where he is not yet convinced and where he still reacts to the learners with a certain amount of automatism. Perhaps Mr Johnson requires that there is demonstrable evidence of significant changes in student learning outcomes *before* there can be true changes in his beliefs which will result in permanent changes in his classroom practice (Guskey, 1986).

#### Conclusion: Floating responsibility

Perhaps the most significant happening in Mr Johnson's class is that he stopped taking responsibility for the learners' learning. Within the MALATI framework, this was a positive step because we do not believe it is *possible* for the teacher to pass on his ready-made knowledge to the learner. However, the problem in Mr Johnson's class is that the learners did not *take over* the responsibility for their learning – it was never *expected* of them to explain, justify or challenge their constructions. They were simply left to carry on with their 'MALATI projects' on their own while sitting, coincidentally, in groups. On the other hand, Mr Johnson did not *take on* the responsibility for monitoring (assessing) their learning process such that he could better choose/design activities and organise his class. We believe that this is the responsibility of the teacher.

I conclude that it is not sufficient for a teacher to give up responsibility for the learners' learning. This responsibility has to be handed to the learners within a culture in which their obligations as learners are clear. And the teacher has a responsibility towards decision-making based on careful and focused and continuous diagnosis of learners' knowledge. If these responsibilities are not clearly defined and appropriately embraced, no significant learning will take place.

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