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## 4. The PMTI's

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Data for this study were gathered in four phases. Phase 1 started at the beginning of the Fourth Year methodology course, when the entire class of FET students ( $n=25$ ) was asked to complete a questionnaire. The information garnered through this exercise was used to select the sub-sample and to provide a launching point for the individual interviews. The second phase of data collection involved the selection and individual interviewing of the sub-sample of six students, based on information from the questionnaire. In the third phase, the students left the campus to do their term-long teaching practicum at various city schools where they were observed and filmed while teaching and their mentor teachers were interviewed and asked to fill in an abridged questionnaire; and finally, upon their return to campus after the ending of their teaching practice, they were again interviewed in the fourth phase of data collection. Three groups of people thus provided information: the students, their mentor teachers and the classroom observer. Data had to be collated and analysed across all four phases in order to answer the research questions.

This chapter begins with a description of the perceptions of the Fourth Years regarding their PMTI. While the entire Fourth Year class per se was not the subject of this study, the data gathered through the questionnaire they completed, form an information-rich background to an analysis of the sub-sample data, and thus provide contextualising information for this qualitative study. The results are presented as follows: the questionnaire data are at first analysed in terms of the whole sample ( $n=25$ ), and are organised around the three aspects of PMTI that are the subject of this study: Mathematics Specialist, Teaching-and-learning Specialist and Carer. This is followed by a detailed analysis of the sub-sample data. First under scrutiny are the influencers of these students' PMTI. Subsequent to this there is a descriptive analysis across two broad sub-sections: how the students perceive their own PMTI in terms of the three aspects, and then how their PMTI is actualised in their practice. Data from both the mentor teacher questionnaire and the interviews with the mentor teachers are discussed as part of the analysis of the sub-sample data.

## 4.1 The Fourth Year class

Who is the pre-service mathematics teacher at UP? Beijaard et al. (2000) investigated their respondents' *perceptions* of their professional identity. In this study also, the Fourth Year students' perceptions of their PMTI were analysed. In Section 2 of the questionnaire, the students were required to indicate and explain how and why they ranked the roles of Mathematics Specialist, Teaching-and-learning Specialist and Carer in their perception of themselves as educators.

### 4.1.1 Perceptions of their PMTI

Section 2 of the questionnaire began with a ranking table in which the students were required to rank the three aspects, Mathematics Specialist, Teaching-and-learning Specialist and Carer, as they perceived them within their PMTI. This table was followed by an open-ended question in which they were asked to explain that ranking. The data from this question were transcribed and coded in Atlas.ti in an effort to understand how these students perceive their own PMTI around the three Beijaard criteria which constitute part of the conceptual framework of this study. Twenty one codes were generated from the data as the students explained what made each aspect important to their way of thinking.

#### 4.1.1.1 Mathematics Specialist

In the ranking exercise, eighteen of the twenty five students in the Fourth Year class placed Mathematics Specialist first. Analysis of the open-ended question in this regard yielded eight different codes in Atlas.ti, providing insight into *why* these students hold to the beliefs that they have concerning being a Mathematics Specialist as a mathematics teacher. By far the most common reason (six out of the eighteen) for attaching superior value to Mathematics Specialist, was the belief that learners cannot be expected to understand mathematical content that the teacher does not understand. Therefore, they explained, sound mathematical education is not possible without the teacher being possessed of sound mathematical content knowledge. Five students indicated that they believed that being a good mathematics teacher equates to being a Mathematics Specialist and that this was how it should be. The third most common belief was that being recognisable as a

Mathematics Specialist automatically engenders respect within a school. The remaining five beliefs about the necessity of the teacher being a Mathematics Specialist were each mentioned by only one student.

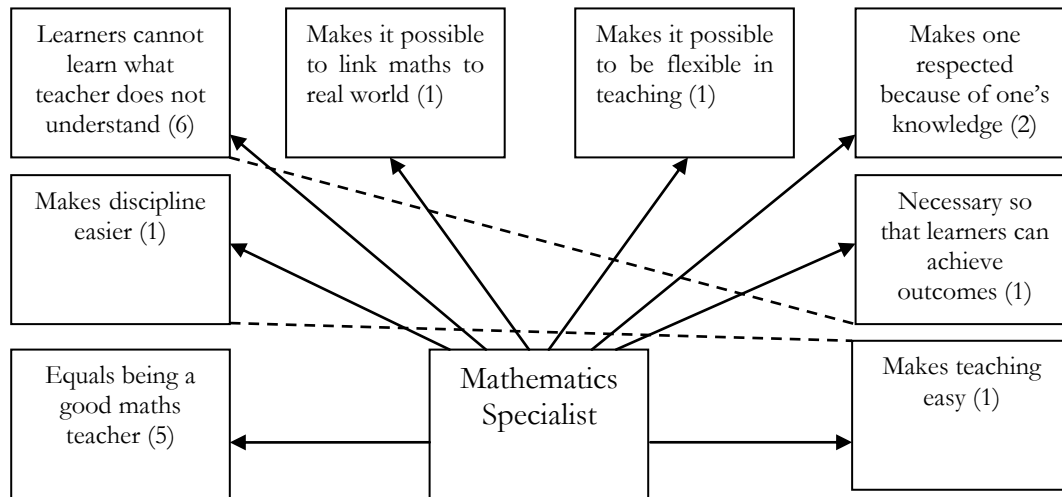


Figure 2. Mathematics Specialist: reasons for prioritisation

The dotted lines in Figure 2 above indicate possibilities for clustering of these codes based on underlying similarities.

#### 4.1.1.2 Teaching-and-learning Specialist

In Section 2 of the questionnaire, the notion of Teaching-and-learning Specialist, or one who is a master of the skills and processes of teaching, was allocated first place by five of the students. All but one of the eighteen students who placed Mathematics Specialist first, placed Teaching-and-learning Specialist second. The most common explanation (given by five students) for this was that teachers should know how to teach. Three students referred to the need for teaching skills to bring about conceptual and not just procedural understanding of the subject in the learners. Two students thought teaching-and-learning specialisation was important because it provided the necessary knowledge of different learning styles to be able to adapt one's teaching to suit. Three other reasons, one referring to the necessity for skills to be able to convey subject knowledge efficiently, and the other two dealing with classroom diversity and the need to make mathematics relevant to real life, were mentioned by one student each. In Figure 3 below, clustering may occur as indicated by the dotted lines.

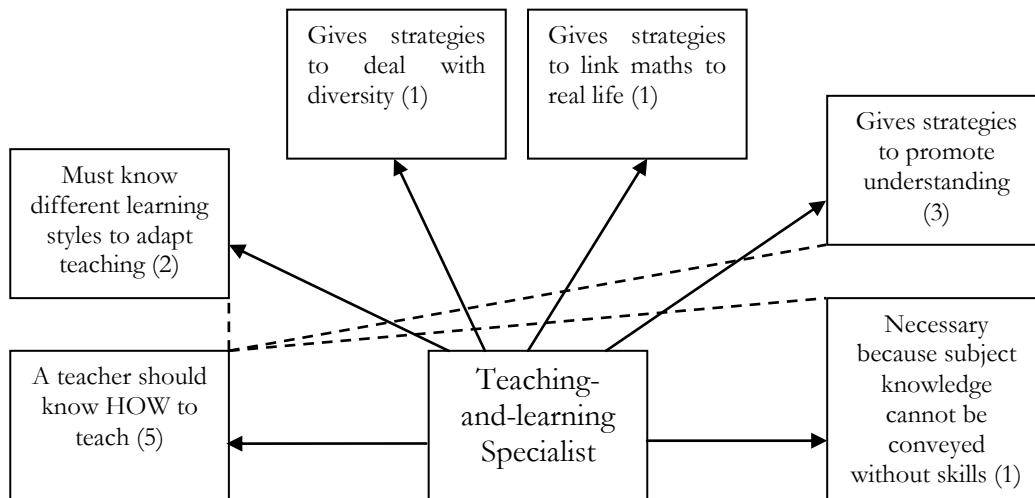


Figure 3. Teaching-and-learning Specialist: reasons for prioritisation

#### 4.1.1.3 Carer

In their explanation of their ranking exercise, very few students even mentioned the role of teacher as Carer, and instead concentrated on why being a Mathematics Specialist and a Teaching-and-learning Specialist were more important. Only two of the twenty five students placed this aspect first in their PMTI. Nevertheless, a variety of beliefs regarding the importance of this aspect were mentioned by the students. Seven different codes were in fact identified, the most common of which (mentioned by three students) described the belief that a teacher should be a moral and life guide to the learners. Two reasons, each referred to by two students, explained that being concerned about the learners as individuals and caring about their personal problems allowed the teacher access to solutions for blockages in their learning of mathematics, as well as making working with multifaceted learners easier. One student thought a teacher should be a role model, another felt that being a Carer allowed her to be more patient with slow learners, and a third believed that being a Carer helped her prepare her learners for real life challenges via the mathematics classroom.

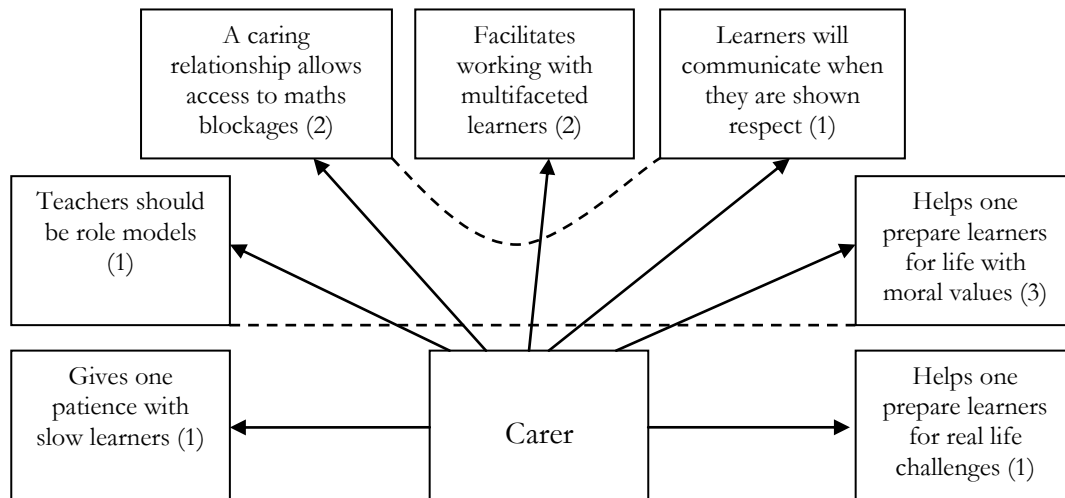


Figure 4. Carer: reasons for prioritisation

The open-ended responses indicated that, although the notion of Carer was not given much weight in terms of point allocations, the students nevertheless were very much aware of the need for and the value of being involved with their learners on a personal yet professional level. One student said, “Learners are made up of their social space/world” and therefore need to be handled as unique individuals. Dotted lines in Figure 4 above indicate possible clustering of these codes.

## 4.1.2 Learning about these aspects of PMTI

The remaining three open-ended items in Section 2 of the questionnaire each began with the statement “With regard to my role as Mathematics Specialist (or Teaching-and learning or Carer) I have learnt that ...” However, the students did not differentiate between their own perceptions of their PMTI and what they had learnt about the three mentioned aspects of PMTI at university. The discussion of the ranking in Question 1 was expanded upon in their descriptions of “I have learnt that...” in Question 2. Therefore these answers actually form part of the discussion in Section 4.1.1.

### *Summary*

Who is the pre-service mathematics teacher studying at UP? Before homing in on the PMTI of such a student, data supplied by the Fourth Year class begins to fill in the background of the picture. Being a Mathematics Specialist is clearly most important to the majority of students in this group.

The students believe that no matter how well one can teach, if one's mathematical *knowledge* is deficient, one is simply not a good teacher. Closely seconding this category in strength is the conviction that no matter how well one knows one's subject, if one cannot *teach* it, one is simply not a good teacher. It would appear, however, that the third category, that of caring, is not one to which the students give nearly as much recognition in terms of the constitution of their PMTI. Nevertheless, this should not be interpreted as a lack of care for their learners. To some students, however, there seems to be a sequential aspect to these categories: one has to *firstly* know the mathematics, *then* one can figure out how to teach it, and *finally* one can think about nurturing the learners. The students did not differentiate between what they had *learnt* about the three aspects of PMTI in question, and their *own* perceptions of these aspects of their PMTI. In fact, the reasons for their prioritisation were generally based on theory they had acquired during their tertiary training.

## 4.2 Insight into students' PMTI: six case studies

It is against the background of the Fourth Year class as discussed above that the six students who were selected to form the sub-sample were initially individually interviewed. For purposes of simplification and easy recognition, the six candidates were given pseudonyms: Martie (White, Afrikaans, female), Ayesha (Indian, female), Thandi (Black, Sepedi, female), John (White, English, male) Thabo (Black, Zulu, male) and Siphso (Black, Seswati, male). Since the initial interview took place before the commencement of the teaching practicum, the questions appertain to influencing factors, as well as the students' perceptions of their PMTI at that time. The individual's questionnaire responses were used as a springboard for discussion. Their responses to the questionnaire were therefore analysed in conjunction with the information gathered through the interview. The codes were inductively generated through analysis of the data. The table below indicates the number of codes that were created as the data were analysed in terms of the conceptual framework. A total of seventy three codes were created.

Table 13

*Influencers and PMTI: Number of codes in terms of the conceptual framework.*

CATEGORY FROM CONCEPTUAL FRAMEWORK	SUB-CATEGORY FROM CONCEPTUAL FRAMEWORK	NO. OF CODES
Influencers	Biography	14
	Tertiary environment	12
	Teaching practicum	18
	View of mathematics	14
PMTI	Mathematics Specialist	6
	Teaching-and-Learning Specialist	5
	Carer	2

The six students were then observed and filmed teaching in the schools where they were doing their teaching practicum. The video clips were studied with a view to analysing the actualisation of their individual PMTI in terms of the three aspects, Mathematics Specialist, Teaching-and-learning Specialist and Carer. The initial codes which were used in this analysis, using Atlas.ti, were those generated through an analysis of the entire Fourth Year class's answers to the open-ended questions around these three aspects in Section 2: the videos were thus coded deductively at first. These codes were used to tag scenes in the videos in order to organise and facilitate discussion of the videos with the students. Then, during the individual interviews that were held subsequent to the completion of the practicum, the video clips of themselves teaching were shown to each candidate and together the student and I discussed the videos and associated codes in terms of the actualisation descriptors in the conceptual framework. The table below indicates the number of codes that were inductively created in the final individual interviews through discussion of the videos.

Table 14

*Actualisation of PMTI: number of codes from conceptual framework*

CATEGORY FROM CONCEPTUAL FRAMEWORK	SUB-CATEGORY FROM CONCEPTUAL FRAMEWORK	ACTUALISATION CATEGORY FROM CONCEPTUAL FRAMEWORK	NO. OF CODES
PMTI	Mathematics Specialist	Mathematics expertise	5
	Teaching-and-Learning Specialist	Evidence of understanding	7
		Teacher/learner-centeredness	7
		Flexibility in teaching	11
	Carer	Evidence and purpose of caring	8

The questions in this second and final individual interview were designed to:

- access the participant's understanding of the subject mathematics in terms of how they teach it (constructivist, Platonist or instrumentalist) and what they perceive as its purpose as well as what their attitude is toward the subject;
- investigate the participant's practice in terms of teaching-and-learning through examination of their locus of control,
- determine what they see as evidence of understanding
- find out how flexible they are in their teaching;
- and ultimately what evidence there was in their observed practice of caring for the learners as individuals.

In the rest of this chapter, the data from the questionnaires, video clips and interviews are used to provide deeper insight into the students' PMTI. Each of the six participants is discussed firstly in terms of the influencing factors within their personal history as well as those that have affected the development of their PMTI, such as their tertiary training and practica. Their view of the subject is discussed as an influence not only on their PMTI but (in the second interview) on the way they teach. Their PMTI is considered under the headings of Mathematics Specialist/Teaching-and-Learning Specialist/Carer through a discussion which includes both what I observed and their own



perceptions of their PMTI. Subsequently, the actualisation of their PMTI is discussed under the heading from the conceptual framework: mathematical expertise, teaching-and-learning skills viz. evidence of understanding, teacher/learner-centeredness, flexibility and evidence and purpose of caring.

Quotes are referenced as follows: (ISI or SSI, or Q, 1:17) i.e. Initial Student Interview or Second Student Interview or Questionnaire, primary document 1: line 17). All quotations are presented exactly as they were recorded in the interviews, so grammar errors have not been corrected, unless meaning became unclear. Mentor Teacher interviews are referenced as (Mentor Teacher interview, 1:12), with the numerals representing the primary document and the line number in Atlas.ti. The Mentor Teacher questionnaire responses consisted of a single short paragraph each and were not coded in Atlas.ti. At the end of each case is a visual representation of that particular student's PMTI according to the conceptual framework. Each figure has a colour key, indicating which of the aspects are high, medium or low in significance or prominence in that particular PMTI. Font sizes also differ accordingly.

### **4.2.1 Martie**

Martie is an Afrikaans student who received her high schooling in a former Model C School in Pretoria. At school she was strong academically, demonstrating a particular aptitude for mathematics for which she earned a distinction in Grade 12. She began to study teaching after spending two years studying first Occupational Therapy and then Construction Management. Her academic record in the Faculty of Education is good, and she has shown herself to be a serious and motivated student. She received additional credits for completing modules that are not part of the BEd degree: Psychology (up to Third year level), Statistics, Criminology and Sociology (the latter three up to First year level). Her overall average is 67% and her average for mathematics is 72%, three percentage points short of a distinction.

#### 4.2.1.1 Influences

##### *Biographical factors*

Martie begins her story about being a mathematics teacher when she was in Grade 10. She had a mathematics teacher who, while able to do the work himself, was unable to explain it to the class in a way they could understand. She, having managed to grasp the concepts, then would re-teach the work to her classmates. This experience would appear to be the actual genesis point of her PMTI and is the result of the coming together of two factors: her ability to understand mathematics alongside of the opportunity to teach it to her class, who lacked her understanding. At this stage in her life she became aware of an inherent desire to teach: “Well, very honestly, initially I wanted to study teaching” (ISI, 3:10). However, despite the apparent clarity of this desire, Martie was not sure upon leaving school about what she actually wanted to do with her life. It is only now, in retrospect, that she is able to see where the idea of teaching mathematics as the career for her actually began. At first, she was unable to define what she felt she wanted to do, and as a result was unable to find a career to match.

“Well, I wanted to work with both children and adults, both individually and in groups. To do both remedial and do like emotional, if I can say that way, like emotional work. Be both creative and systematic and everything at once, pretty much, because I’m... that’s just how I am... I wanted to study medicine and then I wanted to do engineering, just one of those, I couldn’t decide. So I wound up somewhere that the lady told me that occupational therapy seems like what I want to do and one of my friends studied it.” (ISI, 3:26)

So she enrolled for a Bachelor of Science degree in Occupational Therapy (OT), but was not fulfilled by what she was learning: “And, ja, one of my friends studied OT and when she told me what they did I told my parents it’s not it, that’s not it” (ISI, 3:26). Then she switched to BSc Construction Management which she did not find satisfying either. Nevertheless, she was unable to find the career path which she really desired until a particular incident re-awakened the initial ideas she had entertained at school:

“Eventually one day a social worker, one of my mom’s friends- she’s a social worker, they were talking about this little boy, he was sixteen and had just finished primary school but he was too old and the high schools didn’t want him, they couldn’t take him. And my heart just bled for this little boy, I almost told her to give that boy to me for three months, I don’t know why I felt that but

that's what I thought. Give that boy to me for three months, let me work with him and I'll get him back to track that he, like back on track, so that he'd be able to do grade 10. That's what I thought. And then the moment I thought that I realised Ah! That's what I want to do. It's like an aha moment." (ISI, 3:26)

It would seem that her father believed that for Martie to devote herself to a teaching career would be wasting the academic prowess she demonstrated as a learner. However, since no other career choice seemed to be satisfying to her, her father acquiesced, provided she teach a subject that involved her intelligence:

"Initially the mathematics thing was my dad, he said since I'm going to become a teacher and I don't want to do anything else, he would like me to do something that at least requires some mental...some brain power, ja, and something that's a bit of a shortage almost. But I loved mathematics since I was a little girl." (ISI, 3:10)

At the end of two years of pursuing other courses, the almost-buried memories of her school experiences along with the desire to help and to make a difference to young people, combined to make her change to doing a Bachelor of Education degree, which proceeded to confirm to her that this was the career for which she was best suited.

From Martie's account of her personal history, I identify three influencing factors: her enjoyment of teaching while she was still at school; her love of and prowess in mathematics, and her desire to help others by using her skills. While all three of these factors were instrumental in her ultimate career choice, it would seem that her mathematical ability played a crucial role – she could teach her fellows at school because she understood the work better than they; she could choose from a number of courses where high marks for Grade 12 mathematics were required, like medicine, or engineering, or OT. Paradoxically, it would seem, judging by her father's reaction, that her mathematical ability was one of the reasons for which she did *not* embark upon teacher training immediately upon leaving school – teaching would be a waste of such ability.

### ***Influence of the tertiary environment***

In Martie's case, the tertiary environment included a year of training in Occupational Therapy and a year in Construction Management. She therefore embarked upon her teacher training as a seasoned

university student with experience of working in two other faculties. She declared in the initial interview that she believes the BEd course did little for her in terms of preparing her to teach mathematics: “I really...I could’ve studied anything else and do what I do. Maybe it’s just me but... But I don’t know if I really learnt much here” (ISI, 3:60). In the initial interview, in fact, she said,

“Well, I did expect the mathematics to be similar to BSc [Bachelor of Science] mathematics which it wasn’t. It was really easy, or here compared to there and I did expect it to be almost BSc third year level. I don’t think it’s even first year level, very honestly my opinion, so I found it very easy and that was a bit disappointing.” (ISI, 3:58)

She did however indicate in the questionnaire that some experiences during this training *did* influence her thinking, but she associates this with people rather than modules: “The processes I learnt at high school was often better, yet there were some (two) maths lecturers in my three years who influenced and developed my own thinking” (Q, 2:217). She does not consider the BEd course to be good value for money – “we were given the theory (some of it) of how to be a specialist in the pedagogics field, but never HOW to... I learnt more necessary skills in the Psychology and Sociology and Criminology that I have also done [before studying education]” (Q, 2:220). Her particular interest is in modules that deal with personal issues: relationships, people skills and psychology. The bulk of the information in this regard came from courses and modules that she did outside of the BEd requirements:

Ok, ... I did psychology and sociology on main campus, [the latter of] which obviously isn’t required here. I think that a lot of the stuff that I learnt there, I incorporate here, or most of it. There, even in the remedial stuff I learnt everything and more in psychology, so I think if I could, I would probably have made that part of *this* course because it just...it teaches you so much more, especially I think with Psychology 220 the module is about...especially our people skills and so on and it had quite an influence on how- not just how I see people but how I know they relate to me and what I have to do to handle them alright and whatever. And child psychology also, it’s really important and I don’t think here it’s covered enough. I don’t think people really talk much. (ISI, 3:70)

In fact, in the quote above she intimates that these additional modules, apart from sociology, were so valuable that she would like to see them added into the BEd programme. Martie’s perception of the course was that it did not adequately prepare her for the exigencies of a career in mathematics

education, but she does believe that she has generally been taught how to be a reflective practitioner. What she did acquire, according to her, was the discipline to sit down and learn:

MARTIE: If I didn't really feel like it before I would just rather set [put] studying off, you know, I wouldn't go study immediately if I didn't really feel like it but now it's all a matter of - I don't care if I want to, I just do it.

INTERVIEWER: So you've acquired a discipline as far as that is concerned.

MARTIE: Um, ja. I've had it before but not like this and now I know how far I can push myself, which I didn't know before.

INTERVIEWER: And then in terms of learning to teach? Has something changed in your mind with regard to who you are? In that field?

MARTIE: I don't think so. (ISI, 3:64)

Her expectations of the course were therefore not met – she had hoped that her mathematical expertise would be greatly increased and instead she found the work either familiar or too easy. She did not fully subscribe to the idea that changing the course to include more practical experiences would make a positive difference to the quality of training the course offers. What would help, in her opinion, is making the electives more difficult:

“Yes, I would make most of the subjects, well, all of the subjects that I've done I would make harder. Like mathematics, I would do it at least up to a BSc second year level in three years... but I can't see why they [BSc students] have to know more than we do and we have to know the background to be able to teach it. I'd make the course a lot harder and not just for making it harder for teachers...students [need] to know more.” (ISI, 3:72)

Martie's description of her university experiences, particularly those in Education, is dominated by her conviction that the work is too easy and not challenging enough, particularly for someone with her abilities. She places an emphasis on the subject mathematics, and seems to think that the skill to teach the subject is an intrinsic part of that ability – her tertiary training, she says, added little to the knowledge of how to teach that she demonstrated while still a learner at school. According to her, her knowledge of mathematics was not much increased either – this she describes as disappointing. Despite her belief that who she is a mathematics teacher was not much affected through her

university experiences, she acknowledges that there were two mathematics lecturers who “influenced and developed” her thinking, and that at least she acquired a knowledge of educational theory.

### *The influence of teaching practica*

Given Martie’s belief in the inefficacy of the BEd course she is in the process of completing, it is not surprising that in her teaching practicum she harks back to her schooling instead of her tertiary training. She believes that the link between actually teaching at a school and learning about such teaching at university is tenuous at best. Neither does she believe that her teaching practicum experiences have been particularly formative, since she does not believe that she acquired new knowledge regarding how to teach. When asked to speak about her teaching practicum experiences, she did not discuss what she learnt or how she developed as a teacher in any way, other than to say that she had not learnt much that she did not already know. Instead, she described her attachment to the learners and theirs to her:

They all thought I was their maths teacher because theirs was, I don’t know where, somewhere. I don’t know where he was. But I took over his classes for three weeks so it was my class and everyone thought I was the teacher and they almost cried more than I did and I cried a lot [when I left]. It was horrible for me to be leaving them alone. (ISI, 3:44)

What was significant to her, was the caring role she played:

If those that don’t really want to know ... I don’t know if I’d really mind it that much if they don’t listen, if they are able to do it. But the learners themselves are very important to me, I know that most children can’t really learn when they’re upset or something else is going on, so their heads aren’t going to be at work, they’re not going to be listening. So I would like the learners to know that they’re safe in my classroom, that around me there’s a safe environment where they’d be able to confide in me and come talk to me about whatever, and if there’s anything...if there’s nothing that’s fine. They can also tell me if it’s going well, obviously I would like to hear that. (ISI, 3:42)

This confirms that what made sense to her out of the BEd course was information largely pertaining to the psychology of teaching.

When Martie was asked to discuss her teaching practica experiences in general, she focused on her interaction with the learners and their response to her. Judging only by her discussion regarding her

time in a school as student teacher, it would seem that the greatest influence of teaching practice in her life was in her role as carer and the interaction she enjoyed with the learners.

### ***Influence of her view of mathematics***

Martie demonstrates an understanding of the subject mathematics that goes beyond the level of numbers and operations. She indicates an awareness of the subject in terms of its effect on the student thereof: she believes the subject *is* a way of thinking, which involves the use of procedures and symbols:

I'd say that mathematics was a way of thinking, like it's a, um, ja, it's a subject that pretty much teaches you a certain way to think and how to analyse situations, well not just...well, using abstract um, forms like a b c, you know like stuff like that ja, symbols um to analyse situations, but also like methods... (SSI, 7:9)

It would appear that her view of the subject is inseparable from what she believes is the purpose of the subject: to teach learners to think and reason logically. She includes in this the notion of learning to solve problems and to think creatively in order to find solutions. Creativity, she believes, can be demonstrated through the use of manipulatives to clarify learners' understanding of certain concepts. In terms of Ernest's categorisations Martie's view of mathematics seems to be a combination of the Platonist and the problem solving view: she sees mathematics as something to be analysed and learnt in terms of methods, yet she also believes that it is a subject in which the individual can bring their logic and creativity to bear on problem-solving situations.

Her love of the subject is based on the joy she finds in solving problems and "being right": "I like producing [answers] which no-one else can get right; I like to be right!" (SSI, 7:36) This sentiment is echoed in her explanation of why planning is important: "You need to know exactly what you're talking about, you need to know that it's everything that you teach it's...is correct. You need to know that you're right because you can't... I don't want to teach um, wrong content" (SSI, 7:312)

She is, however, aware that others do not necessarily share her enthusiasm for the subject.

...People in general have this psychological block against, well, mathematics. Um, they just, they think about it negatively and if you as a teacher...a lot of the time the children um, attach the same

emotional value to a subject than they do to the teacher, so if they like the teacher and the teacher is positive towards them, they kind of feel like “hey, maybe mathematics isn’t that bad. (SSI, 7:116)

It seems therefore that in her view of the subject, it is something that can be loved, if one can master it, and disliked or even hated if one cannot. So, as a subject, it has an emotional dimension that engenders strong feelings in those involved with it. She came to understand this while she was a learner and her achievement in mathematics dipped when the teacher she liked fell ill, and was temporarily replaced by someone she strongly disliked. She discussed this link between liking the teacher and mathematics achievement with her friends and her mother. They had experienced similar achievement responses to an emotional stimulus (like dislike of a teacher).

#### 4.2.1.2 Martie’s PMTI

In the ranking exercise in the questionnaire, Martie indicated that she believed that all three aspects of PMTI should be equal and were equally important to her. This belief that these three aspects should be in perfect balance is echoed in her initial interview as well as in her responses to the open-ended questions of Section 2 of the questionnaire where she had to describe what she had learnt at university about the three aspects of PMTI. When asked in the questionnaire to explain her prioritisation of these aspects, she wrote,

I believe that in order to teach the best, you have to know your subject field. You have to be the best in what you do. In order to get your subject knowledge across to the learners it is important to be the best in your knowledge of the methods and processes used, especially in mathematics. I also believe that the level of learners’ achievement are based mostly on their emotional, social and moral state. By being a positive influence here, you will increase their performance and achievement. (Q, 2:210)

However, her mentor teacher, in the questionnaire she was asked to complete, described Martie as predominantly a Mathematics Specialist. Inasmuch as the mentor teacher can be thought to have acquired insight into Martie’s PMTI across the three months of working together, it would seem possible that Martie’s belief of what *should* be the constitution of PMTI is belied by her practice. Martie is driven to achieve excellent results in what she does, as indicated in the quote above. In the space of three sentences she used the word “best” three times: “teach the best...be the best in what you do...be the best in your knowledge”. When her declared disappointment in the BEd programme is placed in apposition to this desire to be the best at what she does, it seems as if her



disappointment may be caused by being good at what she perceives as *easy* – hence not the “best” by being good at what is *difficult*.

### ***Martie as Mathematics Specialist***

Martie enjoys mathematics for the sake of the challenge it poses. This love for the subject has been with her since primary school: in the interview she explained, “I just love working with numbers, I love solving riddles and thinking...sometimes you have to think out of the box and sometimes there’s set formulas- I like to do both. So it’s pretty great actually” (ISI, 3:12). She is confident of her subject knowledge, having succeeded very well in the mathematics modules she completed both as part of her education and engineering courses. “So ja, I do consider myself, well, fairly knowledgeable on the subject of mathematics” (ISI, 3:42). In fact, her oft-repeated complaint about the BEd mathematics modules is that they were too easy and did not, in her opinion, give the student more in-depth knowledge than the matric learners the student is being trained to teach.

She sets great store by the conveyance of correct information to learners and by the ability of the mathematics teacher to answer their every question. On one occasion, however, she was unsure of the answer and would handle such a situation as she explained in her initial interview:

Well, if I didn’t know anything that wouldn’t...it happened once that I wasn’t sure about anything, I didn’t mind telling them “Listen, I’m not sure about this. I think I do know but I’d rather not tell you now, I’d rather tell you a bit later. Let me just go make sure about this”. I don’t mind telling them that because I knew they had respect for me for saying that to them because they knew that I would never teach them the wrong thing that I know is wrong, ever. (ISI, 3:50)

In the interview with her mentor teacher, this lady confirmed that Martie is first and foremost a Mathematics Specialist:

I think, in the first place, she’s a specialist in her subject, in mathematics. I think she explains it very well to the children. I think she talks a little bit fast and she’s not always clear with her explanations [in] her speech but she’s very clear with her explanation. I think the children follow her very well but I think she’s a bit quick to explain and then she’s got to do it again. (Mentor teacher interview, 1:8)

Therefore, despite Martie's beliefs regarding her own PMTI, it would seem that Mathematics Specialist is the dominant trait in her PMTI, causing her to teach the way she does.

### ***Martie as Teaching-and-learning specialist***

She declared unequivocally that her beliefs regarding what a good mathematics teacher should be, have not been modified and developed during the course of her studies. Her image of a good mathematics teacher, untrammelled by what she learnt in the BEd course, she described as follows in the initial interview: "Well, it would have to be someone that's funny and obviously smart, um, but not too smart, someone that's able to convey what they're trying to teach, but effectively" (ISI, 3:6). However, the knowledge she has acquired over the last three and a half years did creep into her more detailed description of a good mathematics teacher:

So it must be someone that...well, ja...I guess just gets across what they're trying to teach the children but also someone that takes the learners themselves into account- how the learners are performing, not just their performance but their personalities as well and tries to accommodate the different learning styles and different learning patterns and stuff like that. (ISI, 3:6)

Therefore it seems true to say that what made sense to her during the teaching training, was information about the processes of teaching and learning, in other words the psychological aspects of teaching. These were then absorbed into her PMTI. This, she says, is what she then put into practice in her teaching practicum:

I did consider myself, well, fairly knowledgeable on the subject of mathematics. Obviously I've encountered quite a number of methods to teach... So at one section of the work, say now you're doing functions, I know how to teach about three or four different methods. So I have to do more than one method because I know that a lot of the children when I was in school didn't understand, necessarily like the one method, they understood more than one. So I like to use more than one but not...well obviously I try not to confuse the learners when I teach. (ISI, 3:42)

### ***Martie as Carer***

When she was asked to describe her own teaching style, Martie immediately referred to the way she handled the learners: she saw the main thrust of her teaching as building up the learners, "while getting the subject content across" (SSI, 7:260). She described her style as "well, I like to think of it as being positive and reinforcing um, to children um, instead of breaking them down, encouraging them

to try at least” (SSI, 7:252). Illustrating this point, in the teaching practicum video she is seen to punch the air when the learners give her the correct answer to a particular sum, because, she explained, she was saying, “Yeah! You can do it! You did it right! Thanks, guys!” She believes in creating a positive, upbeat atmosphere in the classroom; she smiles often – “if you look at me and I’m smiling you start smiling as well and immediately you feel better about whatever is going on” (SSI, 7: 204) – because she believes that “If I’m positive then everyone around me is going to be positive” (SSI, 7:196). For this reason, she is very careful when responding to an incorrect answer. For example, in the video she said to a learner who had made a mistake, “It’s right, you just didn’t multiply it correctly”. In her explanation of this scene, she revealed the connection in her thinking between a positive, caring atmosphere, and learner performance:

Because often children, especially at that age can feel that you break them down by saying “you’re wrong!” because then they feel that “I’m stupid, I’m worth...well, if I’m stupid I’m worth nothing” and I’d rather not do that, I’d rather say “*listen, you’re worth a lot to me um, but try doing this differently, then you might get the right answer as well.* (Emphasis added) (SSI, 7:80)

She explained the root-belief behind her nurturing style:

Because children often think that “I can’t, I can’t, I can’t” and I’ve learnt that if someone, an authority figure tells them um, sometimes by repetition that “you can, you can, you can” even if they don’t believe in themselves, eventually they start thinking that “listen, wait, if this person believes that I can maybe I should think about whether I really can or can’t” so they kind of re-evaluate [themselves]... (SSI, 7:88)

However, she could not pinpoint the origin of this belief. She considered the idea of acquiring this belief in the psychology modules she had done, in her own experiences at school, or during her teacher training, but found none of these rang true. Eventually she concluded, “I don’t know. It’s just stuff I learnt about people at various places” (SSI, 7:99). She indicated that this way of responding to the learners was more instinctive than learnt.

Her relationship with the learners appears not just to be based upon a strategy to provide access to mathematical blockages in a learner’s mind, but shows a very real love for children. She described a teaching practicum in which she actually replaced the teacher, and developed close relationships with the learners:

But I took over his classes for three weeks, so it was my class and everyone thought I was the teacher and they almost cried more than I did, and I cried a lot. It was horrible for me to be leaving them alone. I must've done something right because I know they all came up to me, a lot of them came up to me and a lot of them told me stuff that was going on at home or just asked me what they should do because one time two or three boys were fighting and they came up to me after break and said these teachers...they got into trouble for it and I was like "Oh, well what happened?" and they told me, and they asked me very seriously how they should handle it next time and I remember, it was about a week later, the one boy came up to me again and he's like "Guess what? The same thing happened again and I did what you said and it worked!" and I felt like, aw that's so cute. So I must've done something right with that. (SSI, 3:44)

Martie's mentor teacher revealed a slightly different perspective: "She's a Carer, in a way but not really. She's concerned about them but not so much, I think the subject specialist is her best..." (Mentor teacher interview, 1:8). Therefore, as a close observer over the period of a school term, the mentor teacher indicated that Martie, although a caring, skilled teacher, remained predominantly a Mathematics Specialist. In the videoed lessons, Martie is seen to invite the learners to interact with her, but this interaction is limited to responses to her questions and occurs on a right/wrong basis with little discussion.

#### **4.2.1.3 Actualisation of Martie's PMTI**

For the most part, according to Martie, her professional beliefs have their origin in her understanding and interpretation of her own schooling experiences. The dominant theme that colours data gathered through talking to her, is her confidence in her mathematical ability. Martie was videoed teaching classes of twenty three children. On each occasion she presented new mathematical concepts followed by an opportunity for the learners to put the concepts into practice under her supervision.

##### ***Mathematical expertise***

At no point in the observed lessons does Martie falter or make a mistake in terms of the mathematical concepts that she is teaching. Martie's mentor teacher testified in this regard:

She knows the mathematics, that's for sure. You know, you get people who knows the mathematics but cannot explain it because they're just too clever; [they] do not know how to explain it but they know how to do it. But she knows how to explain it too. (Mentor teacher interview, 1:60)

It would seem as if Martie's confidence in her mathematical skills and knowledge is not misplaced. When asked what she was uncertain of in her teaching, Martie could think of nothing. However, in terms of certainties, she could name a few:

I'm absolutely sure that I know what I'm doing. Um, I'm absolutely sure that I know that I have the best interest of every learner in front of me on my heart... Um, I know that and I know, well, I'm good at what I do. Um, I know what I'm teaching them is right um, and I know...I know I have people skills, I know how to work with them. I know how to get the right responses that I want from them. (SSI, 7:328)

Martie was asked to explain the origin of these certainties, certainties which she describes as knowledge:

Well, firstly, I think the root of it all is I know who I am. Um, I know who I have been made to be so that gives me certainty to act in what I know I have to do. If you know you're a...a tractor you can act certain in ploughing a field. (SSI, 7:336)

Ultimately, Martie said, regarding the way one teaches, "I'm pretty sure it's who you are" (SSI, 7:176), thus unconsciously echoing the words of Palmer (2007), "we teach who we are" (p. 2).

### ***Teaching and Learning***

While watching recorded lessons taught by Martie, it became clear that her teaching style is friendly and participatory: she continually invited learners to comment or provide information as to the topic she was teaching. She elicited choir-type responses by suffixing the expression "Né?" (Afrikaans equivalent for 'Isn't that so?') after most statements she made in explaining a concept. However, she was not satisfied with these responses as the sole measure of the class's level of understanding and checked individual work continually by means of the learners' upheld "whiteboards". In reacting to the learners' work as it was shown her, she nodded and smiled if it was correct, and shook her head, still smiling, if it was not. Since her reaction to incorrect answers held no vestige of condemnation or censure, she was able to maintain the level of participation from the class. Not one of the learners observed who submitted incorrect answers appeared in any way crushed or defeated: on the contrary, all seemed eager to keep trying. She used a strategy in which meaning was negotiated as she taught, by asking leading questions and prompting learners to express their understanding and venture suggestions. She explained her belief in this strategy during her initial interview: "I'm always certain

about what they do and why they do it and all the kids are being able to think for themselves so that's better...the more you win" (ISI, 3:50). In this way understanding became a shared experience, instead of a clever lecture. Martie believes that her teaching skills are more intuitive than acquired through modules at UP. However, she testified to the usefulness of the psychology courses she had done; therefore it is possible that at least in part, her appreciation of the fragility of learner confidence was taught, not instinctive. Her friendliness is natural – Martie says of herself that she is always smiling, as indeed I observed.

In the initial interview Martie described a typical lesson she taught as very structured:

I worked very systematically and often I would tell them, "Write down in the little blocks somewhere in your books in colour pen or whatever. Make yourself a little note, here's like a little step for you 'how to do' the specific sum. So these are the steps you are going to use for most of them but you're going to modify them a little, but first you have to look for this then this and then this". And every time they asked me I would ask them, "Did you do the steps?" (ISI, 3:46)

The structure does, however, allow for a repetition of procedure explanations or explanations of various methods. As Martie said in her interview,

I do the one the way...if I can say, the easiest one first, the easiest and shortest way and then if they don't understand I'll go into more detail and do it in different ways- well only for those that does, that really want to know.(ISI,3:42)

From the observation video it is clear that Martie believes that, no matter how structured the lesson, learner participation is essential. She would therefore call on learners by name to elicit responses if they were not readily forthcoming. She also used this strategy to good effect in enforcing discipline or in correcting unwanted behaviour: she would, as she was explaining a concept, mention a learner by name, as if she were having a personal conversation with that learner. This strategy ensured that learners who were chatting amongst themselves were quickly called to order, and that those who were non-participants by habit, were brought into the flow of the lesson. This strategy is mainly intuitive, she believes, although she did subscribe to the teaching she received in her methodology classes in which constructivism in the mathematics classroom was advocated, and she thus tries to be constructivist in her approach.

## Evidence of understanding

Martie explains that initially, when the learners complained of not understanding what she was saying, she just thought that the learners were not listening carefully to what she had been teaching them: “I was just like, guys, weren’t you listening to what I was saying?! Eventually I got [understood] that certain learners are slower than others” (SSI, 7:148). However, she believes that she is able to be patient with learners who “are slower than others”. Part of this patience means that for her, explaining and re-explaining in different words is a useful technique to bring all learners to more or less the same level of understanding. She justifies this technique with the following theory:

Because um, people think differently um, I’m lucky, I have both the creative and the logical like, I have both sides um, I can do both, but other people can only think in certain ways and other people well, ...only think in direct ways. So you have to incorporate the methods of thinking for both learners, um, and that means you have to explain it from different perspectives, hopefully someone understands something. (SSI, 7:156)

Once again, the root of this belief appears to lie in her experiences as a learner and student:

When I was in school, when I was in Grade 10 I think, I had this really horrible mathematics teacher and he was brilliant, but he was a horrible teacher, he really...he went and he wrote the stuff on the board and I was the only one smart enough to be able to understand what he did without a word being said from him. Um, so I’d get up the moment he left class and I would explain whatever happened to the class. And there I saw well, that everyone didn’t understand if he’d just do it his way and if ..., at times people would ask “but can’t you do it this way?” and he’d now realise “oh, this is how they think”. And I studied construction management for a year as well and there I found with um, quantities, the one subject, um, the guy...the lecturer gave us certain formulas to work things out, but there were various methods um, and mine were...every time, every time mine were different than his um, than the one he gave to the class, but mine was the one he would use in practice, um, so there you see um, he just said “yes, but I want them to learn this first because there’s a basic way of thinking, then they can come on and learn the more advanced things”. So you have to think of learners of...at a different level as well because often, I wouldn’t say the smart ones, but often the smarter ones would try to make things more complicated than they really are. Then you would have to find a way to get it almost up to their level to break it down again. So you just have to do different things. (SSI, 7:164)

She is able to see whether in fact her learners have understood and have, to some extent, reasoned the thing out for themselves, by listening to the kind of questions the learners ask, and by finding who does and who does not do their homework – “So you send them home to do their homework and I find very often that a lot of the children that goes home and doesn’t do their homework are the ones that don’t understand” (SSI, 7:300). Eyes are important to Martie. She believes that understanding is reflected in facial expressions, and, in particular, in the eyes of her learners: “... not just that [their facial expressions], their eyes. Um, you can see their eyes are either like it looks like a curtain hanging in front if they don’t understand and if they do understand you can see there’s somebody home” (SSI, 7:304).

She also had the learners work individually on single examples she provided. Their work was done on plastic sleeves with blank white pages in them, so that, while writing with erasable white board markers, each learner could simply hold up their “whiteboard” for her to check their work at a glance. When she detected errors, she would take the time to stop and correct that error with the individual in question, to the satisfaction of both. She did not seem willing, at any point in the lesson, to allow error and misunderstanding to slip by for the sake of time or continuity.

### **Teacher/Learner-centeredness**

In line with her view of mathematics as “a way of thinking”, Martie also believes that her learners should be encouraged to think for themselves. She provokes responses from them, whether individually, or as a group:

Because it’s important for me to know, well, I know that all the learners aren’t going to give feedback all the time. It might only be some learners in some classes um, but sometimes I try to say “what about, ok, what do you think? What then? How do I go further?” trying to make them think further than...you know, not just spoon-feeding them... (SSI, 7:184)

Her goal in teaching goes beyond even having her learners understand the actual mathematics, she wants them to learn skills which would stand them in good stead for life – like the ability to reason for themselves and to act independently:

Obviously I would want them to understand the work but ...there’s more to understanding the work, I want them to be able to think and reason for themselves um, cause that’s what school is



really about, it's not about teaching them something specific, it's about teaching them life skills, basically and I want them to learn that. (SSI, 7:284)

However, Martie tends to explain quite rapidly, before the learners have had a chance to discover truth for themselves. She, in terms of Ernest's (1988) classifications (see Section 2.6.2), appears to be an Explainer.

### **Flexibility**

Planning a lesson is part of her quest for involvement of all learners in her lessons – through careful planning she believes she can stay a step ahead of the clever learners, and she can explain to them what the content of the lesson is aiming for. She also sees that planning helps her to manage the time and therefore discipline in a lesson efficiently, “because if you don't keep them busy, they're going to eat you up and you just have to keep them busy” (SSI, 7:308). At the same time, careful planning provides a base from which she can be flexible in her presentation: “if you have a framework on which to work, you can pretty much cover it any way you want” (SSI, 7:316).

During the lessons that were observed and recorded, she was seen to do any one sum on the whiteboard repeatedly if necessary, until she felt certain that understanding was achieved. This meant that she would use different methods to complete a sum, explaining to the learners that both, or sometimes all three methods were correct, and that although she felt that a particular method was perhaps the easiest, they could decide for themselves. This flexibility could easily be interpreted as a facility with the topic, based on sound subject knowledge.

### **Evidence and purpose of caring**

Martie's PMTI evidences a care for individuals which often appears to have, as its intent, the accessing of solutions to blockages in mathematical understanding. She confirmed this perception in her initial interview:

But the learners themselves are very important to me, I know that most children can't really learn when they're upset or something else is going on, so their heads aren't going to be at work, they're not going to be listening. So I would like the learners to know that they're safe in my classroom, that around me there's a safe environment where they'd be able to confide in me and come talk to me about whatever, and if there's anything...if there's nothing that's fine. (ISI, 3:42)

The care with which she believes learners should be treated is obvious in the observation video. She is seen to leave the whiteboard in the front of the classroom and to bend over a struggling learner's desk, working with him until the problem is solved. She also delivered judgment about the incorrectness of work done by a learner in such a kind way that offence was not caused and confidence was not damaged. She explained the value she attaches to the continued positive attitude of a learner as follows:

They can also tell me if it's going well, obviously I would like to hear that. I would take that into account when a learner performs badly so I would try to set up, say they wrote a test and it went really, really horribly and I know that the learners that usually don't do that badly, I would try to put something to kind of try to lift his marks but not take that away necessarily but just something to help. So I know that that's important, that's important for me as well. (ISI, 3:42)

Martie says she is a reflective practitioner, particularly when things have gone wrong in a lesson, as in teaching a matric class where the learners really did not want to be there – “We did, I think, financial mathematics or something and they just...they had such a hard time seeing ...they didn't get it and eventually they got mad because ...they just didn't want to be in school” (SSI, 7:352). She was confronted with a situation which was unexpected, and her reaction was to analyse both the situation and her reaction to it: “So I sat afterwards thinking to myself, ‘What did I do? What could I have done differently? How could I have responded differently to their responses to me?’” (SSI, 7:352) Her answer was to talk to them about their own futures and their unacknowledged need for knowledge to make their futures desirable. She realises that the positive end to this particular incident is not always guaranteed: “it's good but you can't win them all the time” (SSI, 7:360).

In the video she is seen to be bending over the desk of a learner and talking to him smilingly. However, as she looks at the work he has done in his book she shakes her head and explains again in an apparently friendly way. In discussing this scene, the following comments were made:

INTERVIEWER: Why don't you just stand in front of him and say, right, wrong, do this?

MARTIE: It's closer, personal contact with that specific learner... um... and when you do that, when you give that child that little bit of extra personal attention they often tend to... um, develop better and they um, perform better and achieve better results... They do, they really do and they feel that

there's a connection, you really care about them, you really want them to get this. They're not just someone sitting in your class, you're not just a something to them, you're a someone with a value to them. (SSI, 7:134)

At the same time, Martie does not believe that the learners must be allowed too close; she believes that a professional distance must be maintained:

Yes, there's a definite line, you can't...they're not my buddies, my friends, they're not that. I'm the teacher and they're the student so there's going to...there is a line drawn from "up to this is where I'm friendly" so if I need to be strict, I'm going to be strict and if I need to be honest and you're doing something wrong I'm going to be honest enough to tell you that and for that you need a line. (SSI, 7:268)

That "line" in her thinking separates the professional educator from the pastor: "I'm a teacher, you have...there are hours when I'm going to be available um, if you really do have a crisis it's ok um, but otherwise don't" (SSI, 7:376). According to her expressed opinion in the initial questionnaire, Martie placed the subject, the teaching of it, and the nurturing of the learners on the same level; her opinion does not seem to have changed.

INTERVIEWER: ...Let's say that you had to choose between doing that [teaching a topic] and encouraging the children in your class. Which belief weighs more heavily?

MARTIE: I wouldn't be able to choose. Very honestly, I wouldn't be able to choose.

INTERVIEWER: Ok.

MARTIE: I can't...if teaching subject knowledge with um, would mean costing that child's emotional stuff, I wouldn't do it. But if building a relationship with the child while there's no subject knowledge being taught I would, there'd be no point to it, so I wouldn't do that either. So I really...I can't separate the two. (SSI, 7:270)

#### 4.2.1.4 Summary

The driving force in Martie's ultimate choice of career seems to be her need to share her knowledge with others and her desire to help others come to an understanding of mathematics which is as clear as hers. Her father helped her to focus her intention to teach on the teaching of *mathematics*. As is illustrated in the figure below, Martie's biography is a major influence on her PMTI.

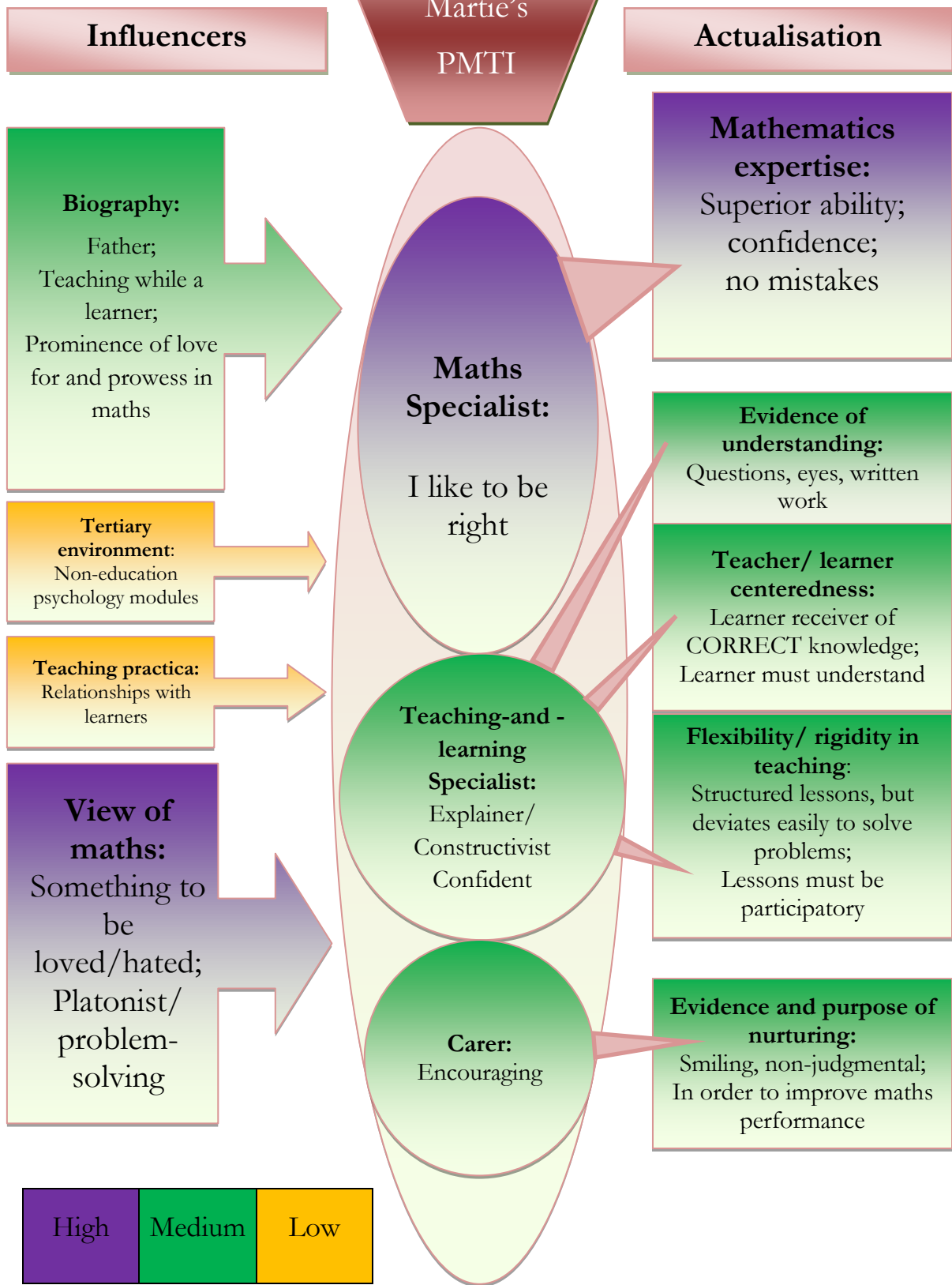


Figure 5. Martie's PMTI according to the Conceptual Framework

At school she demonstrated her love of and prowess in mathematics, and even taught in her teacher's place because she was a better explainer. Her experiences both in class at university and while doing the practica did not rate highly in her opinion in terms of formative value. What she does acknowledge, is a small increase of mathematical knowledge and a useful grounding in psychology theory. In Figure 5, the weakness of these influencers is indicated by the narrowness of the arrow boxes that represent them. Her view of the subject is apparently as great an influence on her PMTI as her personal history. She has a Platonist view of mathematics – what Ernest (1998) describes as seeing it as a connected, consistent, objective structure i.e. it can be understood.

She believes that a good teacher's PMTI should be absolutely balanced in terms of subject specialisation, teaching-and-learning skills and caring. However, this ideal is not clearly manifest in her practice: the figure above shows that her PMTI is not as balanced in terms of its component aspects as she would like to believe it is. As her mentor teacher observed, she is first and foremost a mathematics specialist; the videoed lessons show her as a caring, committed explainer (according to Ernest's model), who will go to any lengths to explain and re-explain until understanding, in her opinion, is evident. She certainly is reflective in that she tries to remediate didactical problems in a lesson and tries to plan for optimal coverage of the required material in the given time without sacrificing comprehension. She *cares*: but she has not yet mastered the technique of maintaining a professional distance without appearing to be more concerned about the topic than the learner despite the fact that she says her main concern is to encourage, so that learners do not fall into the habit of feeling they are unable to succeed at mathematics.

Thus a passionate educator whose PMTI appears dominated by two things: her love of mathematics and her enjoyment of teaching. Her ease of use of the mathematics she teaches is evident in her classroom; her determination to ALWAYS be correct in what she teaches is clearly communicated both in what she says and in what she does in the classroom. In Figure 5, the actualisation of the Mathematic Specialist aspect of her PMTI is preminent. It would seem that it is her aim and desire to put into practice the theory which makes sense to her: learner-centeredness and constructivist teaching strategies. She wants her learners to think and discover for themselves, but finds no way of leading them to the lesson outcomes without explaining and re-explaining while the learners remain passive, so they are receivers of the CORRECT knowledge she shares with them. The Teaching-and-

learning Specialist aspect of her PMTI is illustrated above as ranking below Mathematics Specialist. She sees herself as a Carer, but this aspect of her PMTI is not quite as significant in her teaching as Teaching-and-learning Specialist. Given her propensity for reflection and her belief in the benefits of constructivism in the mathematics classroom, it is possible that the discrepancies between her theoretical beliefs and her practice can be ascribed to a lack of experience.

## **4.2.2 Ayesha**

Ayesha, an Indian student, was educated in a private school in the rural area where she grew up. In the questionnaire she described this school as disadvantaged. Her home language is mostly English. Her performance as a student at university represents steady effort, producing sound results. Her overall average is 58 %, with a mathematics average of 59.3%.

### **4.2.2.1 Influencers**

#### ***Biographical factors***

Ayesha felt very strongly about the influence of her high school teachers and her family. For this student, the beginnings of the belief that she could teach mathematics seem to have been founded in what she experienced as a learner observing mathematics teachers: her teachers, in her opinion, were very traditional and did not do justice to the subject and the learners in front of them. It would seem that at that point already the thought occurred to her that she could possibly teach it better; she could make a difference.

However, she is not conscious of the motivating quality of her high school experiences, and never once mentioned her schooling when asked about motivating factors. Nevertheless, there is a clear subtext in her general conversation revealing her lack of appreciation of the way she was taught at school, and that the thought of being able to teach better than she was being taught did cross her mind. In fact, when asked about her high schooling she did not discuss it from the point of view of a learner in the school, but rather as a clinical observer ticking off its inadequacies: “I think that school, it needs a lot of development because they don’t have any extra murals whatsoever and they have like one or two sports probably. They don’t even have the equipment, nothing whatsoever” (ISI, 1:6).

Her description of a good mathematics teacher was not related in any way to her high school experiences. Rather, she discussed the concepts of learner-centeredness and teacher-centeredness as taught in her tertiary training. She did however compare what she learned to be good practice, with her high school experience:

INTERVIEWER: Let me ask you like this: if you were to walk into a class and teach directly out of matric, would you do it differently to the way you walk into a class now to teach?

AYESHA: I think I would.

INTERVIEWER: In what way?

AYESHA: In...let me say, right now I would teach in a better way...so.

INTERVIEWER: How were you taught at school?

AYESHA: Which subject? Are you talking about mathematics?

INTERVIEWER: Mathematics.

AYESHA: Mathematics, it was just drilled into us. Yes, we had an extremely strict teacher; I think she took us outside the classroom like once. Ok, that's still fine that she at least took us out, but it was just once. There used to be charts in her room but there was no learner-centeredness, there was no interaction- there was some kind of interaction but we used to be more scared of her than liking the subject.

INTERVIEWER: So it was very traditional?

AYESHA: Ja, very traditional.

INTERVIEWER: Did you use the textbook a lot?

AYESHA: Ye...no, this teacher actually makes up her own sums. She's quite good at mathematics so, ja.

INTERVIEWER: But it wasn't very interactive.

AYESHA: It wasn't interactive. (ISI, 1:61)

From this it seems Ayesha's belief regarding good mathematics teaching generally revolves around involvement of the learners in what she describes as an interactive style of teaching.

While her schooling experiences acted as a negative motivator, her family provided positive motivation for teaching mathematics. In particular, when asked what the greatest influence on her was to choose teaching as a career, her answer was: “It was my father, not the mathematics teacher but the teacher part. Because all my life I did want to become a vet” (ISI, 1:21). However, her veterinarian dream did not prepare her for the realities of animal surgery, so she found herself in a quandary with regard to career choice:

Because I have a passion for animals, so I wanted to become a vet, but I think the whole operating and the dissections and all that freaked me out and then my father said, “Become a teacher.” And I thought, yes, children are my second passion. (ISI, 1:23)

Her father, who had been a teacher in India, was able to assist her in identifying her love for children as a reason to teach and it would seem that this deciding moment in her life was based on her father’s input. She then remembered that she was also passionate about children. Her cultural background, of which her father reminded her, played the deciding role. Her father, clearly a strong influence in her life, pointed out to her the cultural requirement of an Indian wife looking after her own children at home.

So he thinks that...because for us Indians it’s better if the woman has a job where she can even be attendant to her children. So he feels that, even during my holidays, they would have holidays also and then I can be attentive to the children. He thought ahead for married life, but I thought about it and then I said that I do like children, I do want to educate the future and I see that there are many teachers who are not qualified but because the schools are desperate they are appointing those. So I said let’s do it. (ISI, 1:28)

While recognising the legitimacy of his motivation and the fact that he had thought ahead of her life as a married woman, she also identified within herself the desire to make a difference to future generations. When asked whether she thought she really could make a significant difference as a mathematics teacher, her reply was emphatic: “Yes, yes!” (ISI, 1:29)

It would seem, therefore, Ayesha’s cultural predisposition to parental guidance is so embedded that her own desires are easily dislocated. In point of fact, her decision to become a mathematics teacher seems to have been based on a process of reasoning rather than an inherent compulsion. She loved children; she wanted to make a difference to them by being a good mathematics teacher, therefore,



“Let’s do it”. Nevertheless, her reasoned approach was not devoid of passion, as demonstrated in her response to the question of whether she really could make a difference. Upon being questioned a little more deeply, she confirmed that in fact she believed that she was born to teach:

AYESHA: “...one can’t really teach someone how to teach, I think it comes to you naturally and...

INTERVIEWER: Or not!

AYESHA: Or not, but I think it is in me, I do have it in me.

INTERVIEWER: So, do you think you’re born to teach?

AYESHA: Yes, I think so. (ISI, 1:48)

Her ambition to become a veterinarian and the notion of being born to teach are in conflict – it is possible that she has tried to convince herself of being born to teach in order to confirm the correctness of her father’s guidance and her decision to acquiesce to it. This explanation is borne out by the fact that she began to doubt the wisdom of her career choice when it was met with disparagement from people for whose opinion she cared.

I just want to add on to that, when I did come to university and people would ask me things like, ‘What are you studying?’ and then I would say, ‘Teaching’ and they would be like ‘Teaching?!’ I got that a lot, I even went into some...ok, it wasn’t depression, but I was a little sad and I was thinking whether I should change my course and...because people around me, they do influence my decisions and stuff because, ja, they’re the people around me. I was thinking whether I should change my course but no, I’m fourth year now, I’m almost finished and I’m going to be a good teacher and educate the future. (ISI, 1:52)

There is a strong sense of resignation and making-the-best-of-one’s-lot in these words. It would appear that the negative views of others regarding teaching as a career very nearly outweighed her father’s positive view. However, having embarked on a course and, in her opinion, being past the point of no return, she settled into an acceptance of her vision of herself as a mathematics teacher since this was in accordance with her desire to make a difference to future generations and to comply with her culture’s requirements.

### ***Influence of the tertiary environment***

Although she feels adequately prepared from the point of view of teaching mathematics, her overall opinion of the BEd course is not high. She claims that many of her initial expectations were not fulfilled. Her disappointment appears to lie in the perceived paucity of practical experiences. She indicated that she felt strongly that improvement in this area would enhance the course. However, positive changes in her thinking regarding the teaching of mathematics did in fact occur:

INTERVIEWER: What changes do you see in yourself as a result of your training here at varsity?

AYESHA: I think...what changes?

INTERVIEWER: Think about yourself in matric to who you are now.

AYESHA: I have changed a lot; there is a lot of personal development.

INTERVIEWER: In what way? Give me some ideas.

AYESHA: I don't know, I just know I have changed a lot. I know that...ok, I think the OPV [Education] modules, they also helped me understand how children think, how you should behave with them and how to deal with children with problems. (ISI. 1:53)

So her tertiary training has allowed Ayesha to believe that she is adequately prepared to teach the subject, and that being a good mathematics teacher requires more than she originally supposed upon leaving school. She also learnt about education theory and educational psychology, allowing her to give an informed opinion of her teacher-centred high school experiences.

### ***The influence of teaching practica***

She believes there is a discord between what she was taught at university and what she actually experienced as a student teacher, and between *the way* she was taught at school and the way *she* taught at school. This may well be ascribed to what Feiman-Nemser and Buchmann identified as the “two-worlds” pitfall in which the more theoretical aspects of teacher training appear to be in conflict with “real world” of the classroom. Her perception is that her tertiary training within the confines of the university lecture halls was not adequately connected to the real-world classroom. She believes the school to have been a better mentor than the university. Nevertheless, she was unable to identify particular aspects of her teaching practica that were significant in her personal development as a teacher of mathematics. Ayesha experienced teaching practica generally as a place where she could

put into practice what she thought was the correct way to teach, while at the same time being guided by an experienced teacher, while her university training was put aside and classified as out-of-touch with the reality in which she worked at a school.

### ***Influence of her view of mathematics***

Ayesha described her view of mathematics as follows:

Ok, I would start off by saying it's a set of numbers - obviously mathematics only works in numbers and digits and it's what...it's how you count and as...as you go to a higher grade it gets complex but when you begin with mathematics it's all about numbers. (SSI, 1:8)

When asked whether she thought mathematics was a finite, closed system, she seemed unsure, possibly because she was not quite sure what the question meant. However, she could think of four reasons why she believed that mathematics was in fact not a finite system: the numbers go up to infinity; the curriculum keeps changing; new research results in new discoveries and new technology is invented all the time (paraphrased). She sees the purpose of the subject as being related to real life practicalities and mental exercise.

There is no question of creativity, other than in the lower grades, she said, where one may use boxes and colours and so on. In fact, in the video she was seen to be demonstrating congruency to a Grade 8 class using pink cardboard triangles. Asked why she did this, she said she was afraid the learners might otherwise find the lesson “boring and dreary” (SSI, 1:106). She also believed this made explaining the concept easier: “And then because I was proving, I was doing something about similarity and so I can actually turn the triangles and show them that they do overlap and, ja” (SSI, 1:118). In Grade 12, according to her understanding, there is no time for creativity in mathematics classes. However, at the same time, she indicated that she believed that creativity was essential since this is what she was taught at university:

I can't remember the name of the module but it was something about the right brain and the left brain and they inter-correlate. I found that very striking because if both your sides, well, the sides of your brain are working, it will be more effective and you would understand better. So in mathematics, when you do something creative, it would awaken both sides of your brain and that's why I think it's important. (SSI, 1:94)

She described her attitude toward the subject as “passionate”. The reason for this was, “because I understand it and want to share it with other people and I want them to understand it too” (SSI, 1:60). In terms of Ernest’s (1988) model, it would seem as if Ayesha’s view of mathematics is an amalgam of the instrumentalist and Platonist views: she believes it to be about numbers, which though infinite, are rule-bound; she admits to new discoveries being made and new developments occurring. As a subject, it can be understood through the learning of steps and procedures.

#### 4.2.2.2 Ayesha’s PMTI

In the ranking exercise in Section 2 of the questionnaire, Ayesha placed Mathematics Specialist first, followed by Teaching-and-learning Specialist, and last came Carer. She felt that this distribution was indicative of balance:

I feel that the category should be balanced. I want to be a teacher who is able to focus on the subject knowledge and skills, the evaluation of the teaching and learning processes and moral development of learners. I feel that all these categories are equally important. (Q, 2:183)

She seemed unaware of any conflict between the ideas she expressed: although she ranked the three aspects very clearly in the questionnaire, in the interview she declares that she believes they should be equal. It would seem as if her instinctive prioritisation in the questionnaire was revised in the interview situation when she thought about how things *should* be.

#### Ayesha as Mathematics Specialist

In Section 2 of the questionnaire, Ayesha linked the importance of being a Mathematics Specialist to the achievement of the learners: “It is important that the learners understand the concept, otherwise they are unable to complete the given tasks and the predicted outcomes would not be achieved” (Q, 2:187). She reinforced this statement during her initial interview, again explaining her beliefs regarding these three aspects of her PMTI:

I do see myself as caring but I feel that I want to be a subject specialist; I want to know my work. It’s no use knowing how to teach when you don’t know what you’re teaching. So that’s why I think that holds the most value, knowing your subject and then knowing how to teach. (ISI, 1:34)

Not only does she value mathematics specialisation as paramount, but she believes that her knowledge of mathematics is such as to make her a Mathematics Specialist:

I have...about the subject specialist until the past two teaching practicals that I did do; I did not get any challenging questions from the learners so I think I am a subject specialist, I'm good at my subject because I didn't get any questions that I couldn't answer or that I was dumbfounded by. (ISI, 1:40)

Her assessment in this regard is based on the belief that knowing more than her learners about mathematics is enough to make her such a specialist. In the video she proves that no learner question goes beyond her knowledge of the topic at hand. Her preparation was in fact very thorough, and the use of manipulatives enhanced the understanding of the learners of the concepts she was explaining. Her lesson was dominated by her determination to convey knowledge in such a way as to allow the learners to memorise the procedure in proving congruency. She reminded them in so many words of the specific three steps required to prove two triangles congruent, and the five steps required to be followed in a specific order for the proof to be completed correctly. The learners having been drilled in this regard appeared comfortable with the procedure, although in-depth understanding as to why the specific procedure was to be used was neither communicated nor solicited.

### ***Ayesha as teaching-and-learning specialist***

Ayesha seemed to confine this particular specialisation to knowledge of how to deal with learning problems in the mathematics classroom:

It is important to be a life-long learner. There are different kinds of improvements in world of education and one needs to be aware and alert about these implementations. One also needs to know if learners are struggling and what needs to be done. (Q, 2:190)

Judging by the following statement in her initial interview, Ayesha believes that didactical expertise is not something one can be taught: "I see you did try to teach us how to teach but one can't really teach someone how to teach, I think it comes to you naturally..." (ISI, 1:48). The instinct to which she refers takes precedence in her classroom practice, because, to her way of thinking, that is as it should be.

However, this instinct seems to have been at least partially influenced by what she experienced during her own schooling: she teaches while the learners listen. Ayesha believes that, as a mathematics teacher, she should explain repeatedly until she feels understanding has been reached. In order to facilitate this, she breaks down procedures into recognisable steps.

INTERVIEWER: Alright. As a mathematics teacher, what are your personal goals in the classroom?

AYESHA: Personal goals?

INTERVIEWER: What do you want to achieve?

AYESHA: I want them to understand mathematics. I don't want them to just say "Step A, step B, step C", that is just for them to get the marks. I give them the steps for them to get the marks but I also want them to understand mathematics and like it. (SSI, 1:340)

### ***Ayesha as Carer***

Ayesha described herself as someone who is passionate about children. When her father suggested teaching as opposed to veterinary science she said, "Then my father said become a teacher and I thought "yes, children are my second passion" (ISI, 1:23). Nevertheless, in the ranking exercise, Carer came last. In the initial interview she explained that being a caring educator, which she equated to learner-centred teaching, was not easy:

AYESHA: So it's difficult to always make it learner centred, group work and for learner interaction.

INTERVIEWER: Ok, so in one word, no, one sentence- a good mathematics teacher is someone who...?

AYESHA: Someone who takes the learners' differences into consideration.

INTERVIEWER: Ok, very good. What do you mean by that? Do you mean learning, personality?

AYESHA: Learning differences. Also background differences because some people are depressed, some people have ADHD and ja... (ISI, 1:10)

From this it would appear that to Ayesha, being a good mathematics teacher implies knowing one's learners and being able to take into account the diversity in the classroom as well as the personal difficulties which may be impediments to learning. She also indicated that tact was required in teaching in a differentiated way, so that learners were not embarrassed or made conscious of each

other's personal problems in the classroom situation. She elucidated her belief in this regard with the following anecdote:

AYESHA: ... Not that you should treat them differently. Like you don't make everyone aware of it, of their problem. They shouldn't be put in the spotlight but you, yourself, should be aware of it and then take that into consideration with any decision making or situation.

INTERVIEWER: How would you take that into consideration when you're making a decision?

AYESHA: Like, just today my friend was telling me that she was teaching English and she was doing this poem about an abandoned bundle where this woman gave birth but she did not want the child so she just threw it away and then the teacher said it would be better if she [the student] didn't do it because there was a learner who just had an abortion; so in that way taking the learner into consideration. (ISI, 1:17)

Part of caring, according to Ayesha, is the notion of the teacher leading by example:

Learners tend to look up to their teachers as role models. In order for the learners to be morally well developed, we as teachers need to be an ideal icon. Learners do not do as they are told to; but they follow what they see, therefore we have to practise what we preach. (Q, 2:193)

Thus it would seem that her belief regarding what constitutes a good teacher means that not only does the teacher care about the problems of the individual in as much as these hamper learning, but such a teacher must in her conduct also be a moral preceptor. In the video footage of Ayesha's teaching, it is noticeable that Ayesha maintains a dispassionate distance from the learners and does not enter into personal interaction with any learner either during the actual teaching part of the lesson, or during the part where she walks amongst the learners as they complete the examples she gave them. Therefore it would seem that Ayesha's beliefs regarding being a caring educator do not include casual interaction during class time. She explained in her initial interview that her understanding of caring involved a sort of counselling situation: "Well, there weren't any situations where I had to care for the children, like someone who had a special need or something. I do care for them but there was no specific situation, ja, there was no opportunity" (ISI, 1:40).

Ayesha's mentor teacher seemed to think that this particular aspect of PMTI was not well developed in this student, but explained that the context of the mathematics classroom did not lend itself particularly to caring:

Due to time constraints, we as mathematics teachers are governed by the number of minutes a mathematics period has. We need to concentrate on completing subject knowledge and skills and are sometimes unaware of the evaluation of the learning process and socio-economic and moral development of the learners. With experience to different schools and learners, I am sure that [Ayesha] will develop in the categories that she lacks. (Mentor teacher questionnaire)

#### **4.2.2.3 Actualisation of Ayesha's PMTI**

This student demonstrates a determination for the learners to be fully occupied throughout the lesson, so that there is no time for discipline problems to arise. Her lessons were well-structured and organised, and the learners behaved circumspectly.

##### ***Mathematical expertise***

Her approach toward the content in her lessons tends to be formal, demonstrating her confidence in the subject's reliability in terms of consistency, logic and precision. She values procedure as a means of ensuring that the learners are able to score marks in a test; knowledge of the procedure, she believes, builds confidence in the learners and gives them the know-how required to do the sum:

INTERVIEWER: Now you've taught them about congruency, a very...very tight procedure.

AYESHA: Yes.

INTERVIEWER: Um, do you believe that giving them the procedure like that helps them?

AYESHA: I think so.

INTERVIEWER: Why?

AYESHA: Because then they...they know which way to go. They know where to start and where to end, otherwise if you just give them a sum and tell them to do it they wouldn't know where to start. So it's just, basically, to mould them to...ja, to know which steps to follow. (SSI, 1:192)

True to her experience on previous practica, no question posed by learners was too difficult for her to answer accurately and with apparent ease. By her own standards then, she qualifies as a Mathematics Specialist. She was able to teach the mathematical content confidently and she certainly knew the procedures off by heart.



## *Teaching and Learning*

The video footage of Ayesha shows her to be a confident educator, clearly aware of her mastery of the topic at hand. The satisfaction of being able to impart this knowledge successfully to others while doing her teaching practicum served to confirm her belief in herself as a mathematics teacher: “The actual teaching, I have experienced it quite a few times that after I have explained to the learners I see the “Oh!” and it feels so good to see that...” (ISI, 1:42)

She, like a case described by Thompson, expects her learners to “assimilate the content. Assimilate means ‘see’ the relationships between the new topic and those already studied, as explained by the teacher” (Thompson, 1984, p. 63). In order to make sure that this “seeing” happens, she is willing to explain the same thing several times and will repeat instructions if necessary. In fact, the only situation which would make her nervous while teaching would be finding that the learners do not understand despite her many explanations:

AYESHA: Ok, what I think would make me nervous is when learners don’t understand.

INTERVIEWER: No matter what you do.

AYESHA: Yes, yes. When I don’t know what to do with the situation, I think that would make me a little nervous.

INTERVIEWER: Has it ever happened to you?

AYESHA: Um, it hasn’t actually.

INTERVIEWER: But it can.

AYESHA: But the thing is, maybe I don’t know if it has happened because what I do, I explain to them as many times as they want to but I haven’t reached a point where I can’t explain to them anymore. But I hope that point never comes. (SSI, 1:394)

In the video clip it was clear that repetition of process and re-explanation were techniques she firmly espoused:

INTERVIEWER: Ok, now you’re explaining procedure, following very tightly what you said before and here they are doing the sums, you’re reminding them of things. Now you’ve explained angles to them before, why do you do it again? You’ve explained alternate angles during the lesson.

AYESHA: Ja, because I've noticed that uh, there's lear...there's different levels, there's learners that learn quickly, there's learners that are learning slow. You have to explain to them two or three times, so I was just keeping my options open.

INTERVIEWER: Ok.

AYESHA: I was trying...trying to accommodate all the learners. (SSI, 1:236)

The statement above indicates a belief that multiple repetition brings about understanding - at least enough to be able to complete the task at hand successfully.

### **Evidence of understanding**

Observation of her teaching style revealed that she applied herself to making the topic accessible to all the learners, not just to dealing with stragglers. She was able, through using different examples, to explain the meaning of the congruency of triangles in such a way that the particular steps which had been taught were reinforced and that very few questions were asked by the learners, given that the procedure was simplified into five easy steps. She interspersed her teaching with chorus-answer type questions which may be interpreted as symptomatic of a desire to make sure that everyone understood all of the time. She appeared to believe that such answers were true reflections of the learners' understanding. While the learners were given the opportunity to complete individual exercises in their books, she walked around the class repeatedly, checking their work, but not pausing to interact on a personal basis. In this way, she says, "And I also know what they understand and what they don't. If...if I see a common mistake I know I should emphasise on that" (SSI, 1:262). At the same time she is able to maintain a certain atmosphere in the class: "Uh, the learners feel that 'she's on my back the whole time' and they do work, they don't mingle" (SSI, 1:253). She claims to have begun believing that this technique is effective while still at school herself. This is not her only means of establishing whether the learners understand as she teaches:

INTERVIEWER: Ok, alright. What do you see as evidence that the learners are understanding what you're saying?

AYESHA: When I walk around I...Oh! Ok, when I'm standing in front, sometimes they ask me questions and when I answer the questions they go "Oh!". I actually love that look, I love it, it makes my teaching worth it, ja, and...

INTERVIEWER: Like a reward.

AYESHA: Yes, it's just rewarding, very rewarding. Ja, and um, and even when I walk around I look into their books and I see that they have followed the steps or even if they did it another way and they still got it right then I know they have understood it. (SSI, 1:351)

### **Teacher/Learner-centeredness**

Ayesha believes that she knows how to teach mathematics and that that implies active participation on the part of the learners. In fact, in her initial interview, in answering the question about her understanding of what a good mathematics teacher is, she opined,

A good mathematics teacher? Well, I would describe a good mathematics teacher to be strict but approachable. Firstly because the learners need to know that you mean business and they also need to know that they can ask you any questions if they have any problems and I think everything should be balanced, like there should be learner-centeredness, but at times you also need teacher-centeredness... (ISI, 1:8)

Although the effect of her studies is clearly discernable in the tenor of her answer, she did not explain how she arrived at an understanding of the concepts to which she referred or how the balance she spoke of may be achieved. However, the type of interaction she had in mind is clarified by her answer regarding her style of teaching:

INTERVIEWER: And your own style? Do you involve the children?

AYESHA: Yes, I do. Every time, almost after every sum I want to make sure they are following, I always ask them if they're following, if they understand and if they have any questions. I try to be as approachable as I can. (ISI, 1:74)

It would seem therefore that her understanding of interactive teaching in a learner-centred way implies only concurrence with what she has said or enquiries about concepts they might not have understood properly. This is borne out by observation of the video footage of her teaching. Ayesha favours chorus-answer questions like:

Do you all understand?

Angle A is equal to...?

Angle B is opposite Angle E, isn't it?

Side AB is equal to side BC, yes, no?

No participation from the learners beyond answers to questions such as those above, or posing their own questions when they do not understand, is invited or encouraged. The learners are not prompted to suggest their own explanations or theories to explain the geometric procedures with which they were busy.

Again like the case described by Thompson's (1984), Ayesha believes that "the teacher must establish and maintain an atmosphere of order, respect and courtesy in the classroom" (p. 63). She believes that questions must be dealt with immediately, as they arise, and while the learner still remembers her concern and has the courage to enquire. She also believes that posing questions to the class as a whole is more effective than posing a question to an individual:

I want involvement from everyone. I know if I ask one person then they will all be awake and they'll think "she might ask me now, she might ask me now" but I don't know, sometimes I just prefer asking the whole class. (SSI, 1:134)

Asked why she favours this technique, she explained that individuals might be uncertain and would slow the whole lesson down while they wonder about the answer. If however the answer to the question is obvious, she sees the question as rhetorical, simply a mechanism to keep the class moving along through the work. In the video it can be seen that she believes in continuing to talk while she is writing on the board, with her back turned to the class. She explained that she does not think it wise to stop talking in order to write:

I think if I...I stop and write then they might start talking at the back [of the class], I do have some sort of hold upon them but still, if...if I stop talking they stop listening so that's why I think I continue to talk. (SSI, 1:154)

From this it may be concluded that, while Ayesha firmly believes that the learners should participate actively in the lesson, that participation lies between the strict boundaries of responding to her questions, or posing questions regarding the work immediately before them. Discussion is not something she encourages for any length of time. Locus of control rests with her. When learners appear to be deviating from the strict hold she has on the lesson, she gives them "the silent treatment":

AYESHA: I think they were doing it repeatedly, I think something was going on there.

INTERVIEWER: Now why do you just look and not speak?

AYESHA: It's just... what...what do they call it? Silent treatment.

INTERVIEWER: Ok, so you gave them the silent treatment.

AYESHA: Ja.

INTERVIEWER: Ok, do you find that that sort of sternness is effective?

AYESHA: It does, it works, it works.

INTERVIEWER: Why do you believe that?

AYESHA: Because I have experienced it and I then I just give them a look and then they just stop whatever they're doing because they know what they're doing is wrong and as soon as you look at them and you just don't say anything they...they just stop it, ja. (SSI, 1:205)

In her style of teaching, Ayesha combines two of Ernest's models: she is at times an Instructor, presenting procedural information accurately and intelligibly, and at other times an Explainer, willing and able to explain a concept or procedure repeatedly and from different perspectives.

### **Flexibility**

Planning a lesson is very important to her, since she believes that planning is what directs the lesson toward the desired outcome, while at the same time facilitating the maintenance of sound discipline:

I think you have to plan a lesson, it's very important. You need to know what you want to achieve from the lesson and also you can't just go to a class and just do any work with them. You need to keep them busy and on their feet the whole time, so you have to be prepared for every lesson. (SSI, 1:362)

Her planning is designed to provide direction and content for the lesson from beginning to end, so it does not allow her to be flexible in her presentation. Thus in Ayesha's case, her planning provides a structure for lending rigidity to the lesson rather than flexibility.

### **Evidence and purpose of caring**

At a certain point in the video clip, Ayesha asks the learners to determine the magnitude of a particular angle. Although most of the learners are unsure, several venture ideas and make suggestions as to how the answer may be found. Instead of pointing out their errors to them, Ayesha smiles and says, "No, no, no, no". She explains her response by saying,

I think it's for them to keep on trying, it's so that they don't feel...because there's many children that if...if you say no they feel "maybe I shouldn't ask again" or "maybe I shouldn't try again" so I did not want to condemn them from participating in class because I know in class if you give an answer, you'll remember it and even when you're writing an exam, you'll remember "hey, I gave that answer". So I did not want to condemn them from not participating in class. (SSI, 1:170)

Clearly, Ayesha believes that learners should not be discouraged by a harsh attitude, but at the same time her response is very definitely negative. She appears to believe that her smile counteracts the negative "no, no, no".

She also believes that the learners need to perceive her as available and approachable if they are experiencing problems. Nevertheless, the general topic for discussion at such times would be mathematical issues, not personal ones, "Because I am, how do I say this? I don't mind them coming to me if they have any queries, even after school, it's fine, I'm willing to help them out" (SSI, 1:278). When asked to describe her own teaching style as observed in the video, she re-emphasised this point:

Yes, my teaching style. I believe in being firm, equal...treating all learners equally. Uh, well there might be instances where the learners...some might need more help, that's why I walk around if they have any questions to ask and many people they feel shy thinking that their question might be a stupid question, that's why it's better that I walk around and then they can...how do you say it? Like confide in me and ja, ask some questions. (SSI, 1:326)

While her observed technique and even her explanations confirm that Ayesha sees interaction with her learners as mostly professional – about mathematics – she holds a belief that she needs to be available also as a personal counsellor:

INTERVIEWER: Do you think it's important that they trust you?

AYESHA: Ja, very much.

INTERVIEWER: Ok, good.

AYESHA: Because even if some learners have problems at home and they don't know who to talk to, I might be able to help them so it's not just in the classroom situation but if they trust me maybe with their personal matters then maybe I could help them.

INTERVIEWER: Would you be available?

AYESHA: Yes, I would. (SSI, 1:327)

Even such a discussion about personal issues is seen as having professional concerns at the core:

There's people who learn quickly, there's people who learn slowly, there's students who at home have extra tuitions so when they come to school they are prepared, they know what you're talking about and then there's other students who have no idea what you're going on about because there's no one helping them at home, they have dishes to do, they have chores to do, they can't finish their homework in time. So I think it's better to be available, it's very important actually, it's very important to be available after school if they have any questions or any problems that they need to share with you. So it's vital to be available. (SSI,1:430)

Thus, while Ayesha sees herself as a Carer, this nurturing appears to be motivated by the concern that learning is hampered by emotional or personal problems, and that if learning outcomes are to be achieved, the teacher has to be available as an uninvolved counsellor who can help to remove personal issues which are barriers to learning. Despite what she says about caring for the learners on a personal level, this “care” has an ulterior motive – its purpose is to eliminate blockages to understanding, which, as an “explainer”, is her main mission.

#### 4.2.2.4 Summary

Wanting to make a career of veterinary science, Ayesha was persuaded by her father that culturally she was required to be at home in the afternoons so that she could be with her own children, one day. Therefore teaching was a suitable career – mathematics education in particular, since she was good at the subject. She was persuaded on two accounts: she set great store by her father's opinion; and the exigencies of her culture made sense to her. At this time she was able to identify within herself a love second to her love of animals: she also loved children. This student did not originally want to be a teacher at all. However, while a learner at high school, she was taught mathematics in what she describes as a very traditional way, and the thought occurred to her at the time that she could do a better job of it. Her teacher was good at mathematics, but did not teach in a way that involved the learners. Nevertheless, in observing Ayesha teaching, the influence of her high school mathematics classes can be seen – she teaches procedure which the learners have to memorise. Interaction between her and the learners is very limited. The strength of her biography as an influence on her PMTI is represented in the figure below with a large arrow block. Ayesha's tertiary training allows her to put a name to what she had observed as a learner: the class was very teacher-

centred. In her personal history there appear to be three influencers: her conviction at school that she could teach mathematics better than her teacher, her father's opinion, and the exigencies of her culture. Her tertiary training seems to have influenced her only in terms of the acquisition of educational theory regarding the psychological aspects of teaching. Teaching practicum served to confirm to her the differences between tertiary training and the real world of the classroom. Ayesha's PMTI was certainly developed through the tertiary training she underwent, but her "sense-making" of what she was taught during this time was filtered through existing beliefs of what mathematics teaching is in practice: the teacher teaches and the learners respond according, usually, to specific prompts. Her tertiary training and practica experiences are represented as smaller arrow blocks in the figure below, as they appear to be of less significance than her biography and view of mathematics in her PMTI. Therefore, while she accepted what she had learnt at university as useful in helping her to teach better, when juxtaposed with the reality of classroom practice, the university's influence became irrelevant. Ayesha's view of mathematics is a combination of Ernest's instrumentalist and Platonic views: she sees it as a set of rules which can be learnt; a body of knowledge that can be discovered with the help of a teacher who can teach the necessary procedures correctly.

Ayesha sees herself primarily as a mathematics specialist, although she believes simultaneously and without apparent internal conflict, that the three given aspects of PMTI should rank equally in one's professional identity. In terms of Ernest's model, Ayesha would seem to be both an instructor and an explainer whose mission it is to transfer information as accurately and intelligibly as possible to her learners. Chorus-answer questions are used to assess learner comprehension. She also evaluates the expressions on their faces, looking for the Aha! moment of understanding. She knows her subject and seems comfortable answering the few questions that arise. However, questions outside of the 'perimeter' of the lesson plan are not encouraged. She believes that a good lesson is an interactive one – yet her lessons are not designed to encourage learner participation. This apparent conflict is resolved when she explains that she makes a point of asking the class continually whether they understand. They answer in chorus. She describes this as interactive teaching. Ayesha is particularly concerned with discipline, and believes that if she stops talking or allows the learners a freer participation, discipline will be lost. She believes a good teacher is a moral preceptor who cares about a learner's problem inasmuch as they inhibit learning. She is friendly, without being particularly warm or caring in her attitude.



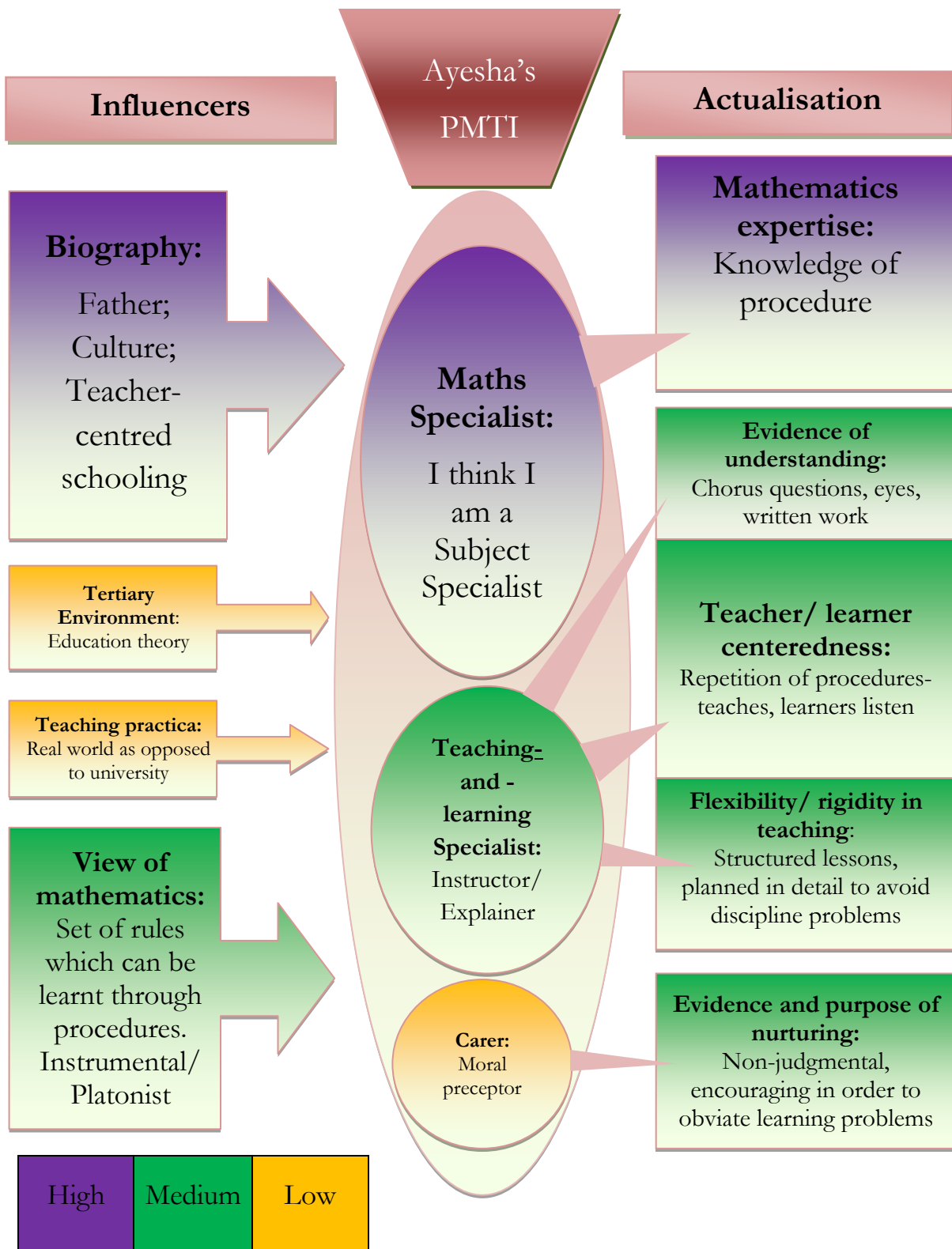


Figure 6. Ayesha's PMTI according to the Conceptual Framework

## 4.2.3 Thandi

Thandi is a black student who was educated in a private church school in a black township near a large city. She passed mathematics in Grade 12 with an E symbol – between 40 and 49%. She enrolled into the BEd course in the Faculty of Education, UP, immediately after matriculating, completing her degree in five years, instead of the usual four, since her first year was spent on foundational courses in the sciences, English and mathematics. This “bridging” year, which is intended to bring students onto a level where success in their tertiary studies is more likely, allowed her access into the BEd course. Her academic progress in the BEd programme was good, ending with an overall average of 61%, but her mathematics average was 53%, only three percentage points above a pass.

### 4.2.3.1 Influencers

#### *Biographical factors*

In her interview, Thandi identified her reason for choosing mathematics education as a career as simply her love for the subject.

“I’ve always loved mathematics, even though I did badly in mathematics in high school. I love mathematics because, especially geometry. I was bad in geometry but still I loved it. Why? Because it challenged me and it made me to think out of the box...” (ISI, 2:9)

She added to this by explaining that mathematics was taught selectively in her school, in that certain aspects were emphasised and others neglected or abandoned. This, she claimed, made her want to not only conquer the neglected topics, but teach them properly, in contrast to her own experience.

I went to a private school and they were setting their own question papers at the end of the year so they neglected some of the chapters in the syllabus like geometry. They did not do much geometry like in grade 10 and then we had to...maybe they give us a handout this week, next week we are writing an examination and they, uh, pushed mathematics negatively with some chapters. So I just want to be a mathematics teacher and then learn to love those chapters, because I already love the chapters that challenge me but then learn the [neglected] chapters and be able to teach learners. (ISI, 2:9)

When asked whether she was influenced in her career choice by any particular person, she indicated that the choice was based on an inherent factor.

INTERVIEWER: ...Were you influenced by a particular person?

THANDI: Not really, Ma'am.

INTERVIEWER: Not your family or your teachers?

THANDI: No.

INTERVIEWER: So it really just comes from inside?

THANDI: Yes, Ma'am. (ISI, 2:10)

Nevertheless, her response was not delivered with passion, nor with any further elaboration of this idea. It seemed necessary, therefore, to delve further into her reasons for becoming a mathematics teacher. If she did not see it as something she simply *had* to do, then why, apart from loving the subject, which could easily have led her down a different career path, did she choose to *teach*? The answer seems to lie in the following quote: "The other thing, when I enrolled to become a teacher I just wanted to be a better person, a person with a profession, to start something of my own" (ISI, 2:30). She seemed to perceive a teaching career as one that would give her status in the community, that would make *somebody* of her. Therefore, her choice may be seen as one driven, not by the passion to teach, but by the desire *to be a teacher*, and that of a sought-after subject like mathematics. Having such a position would then allow her to go back into the community from which she came and change things.

INTERVIEWER: Would you like to teach at a school like that?

THANDI: Yes, Ma'am.

INTERVIEWER: Why?

THANDI: To change things.

INTERVIEWER: So you see yourself as a pioneer, going to go and fix it!

THANDI: No, Ma'am, not to change the school as a whole but if you want to see the change then you have to be the change, like to start in your own space. (ISI, 2:41)

It would appear therefore, that this student has a very specific idea of the position of a teacher in her community and the possibility for bringing about change which that position allows. Her experiences as a learner in her particular high school did not birth within her a passion to teach, but rather a passion to be someone who could bring about change in the dynamic of mathematics education at that sort of school.

### ***Influence of the tertiary environment***

Thandi has strong positive feelings about most of her experiences as a BEd student. The factor about which she is slightly less sure concerns the practicalities of teaching: she indicates that she is not absolutely sure about how thoroughly she has been prepared to *teach* mathematics. However, when asked in her initial interview what she would like to see changed in the BEd course, she spoke not of practical experiences, but of psychology modules:

Ok, I think here at varsity there are some things here by modules, they repeat some stuff, like maybe OPV [Education], JPS [Professional Studies] or just OPV. Maybe do psychology in first year and they repeat psychology in third year and it's a lot of work and it's a waste of time, that's just what I would change. (ISI, 2:38)

Judging by this statement it would seem that Thandi is not as interested in the psychology of teaching as she is in the more clinical aspects of the subject of mathematics itself. She emphasises her belief in the importance of subject knowledge:

So I wanted to know more about the teaching profession, what it entails and the other thing, I wanted information about the subjects which I'm going to teach and then more information- not just come here and then they teach me using high school textbooks just because I'm going to teach high school and stuff. I expected more information, the teacher information like maybe in mathematics. We didn't use the high school textbooks; we did mathematics in tertiary level, not in high school level. If we use mathematics in tertiary level, obviously you will be able to teach mathematics at high school level and primary school. (ISI, 2:30)

Thandi is very conscious of the changes that have come about within herself during her tertiary training. She explains as follows:

INTERVIEWER: ... Now, let me ask you more specifically, question 6: what changes do you see in yourself as a result of your training here at varsity?

THANDI: Ok, from first year to now. In my first year I just wanted to be a teacher, make a difference and go and teach and stuff. Back then it was *just* about passing on the knowledge that I have, but now I realise that it's much deeper than that. And the other thing, as a teacher you're not just there to explain knowledge, you are there to teach learners, to facilitate the lesson and to help them learn by themselves, to direct them. (ISI, 2:35)

From this it would seem that Thandi was positively influenced by subject content modules and methodology modules. In this single quote there is evidence that Thandi's PMTI has developed in all *three* areas as identified in the conceptual framework: "Back then it was *just* about passing on the knowledge" indicates change in the domain of subject specialisation; "you are there to teach learners to facilitate the lesson and to help them learn by themselves, to direct them" - this speaks of teaching skills, therefore there has been change with regard to the domain of teaching-and-learning specialisation; and thirdly, "you learn from the learners and they learn from you..." is suggestive of growth in the area of caring specialisation.

### ***The influence of teaching practica***

In this area Thandi was less sure of herself and in fact spoke very sparingly about her experiences on teaching practica. In the initial interview she seemed to fall back on the theoretical knowledge that she had gained during the course of her studies rather than discuss how she actually experienced the mathematics classroom as a student teacher. She was more comfortable talking about the state of the school:

INTERVIEWER: Now at the school that you're at at the moment you said it's a bit chaotic. What would you change?

THANDI: I think the thing, the organisation of the school, like start with the principal and the discipline and the other thing, I think that school doesn't think that...it's in a block of flats so it doesn't feel like every teacher has his or her own classroom. It should be teachers who move around and go to the learners, not learners moving from one class to the other because of the small passages...

INTERVIEWER: It's just chaos?

THANDI: Yes, Ma'am. And then they take ten minutes to get to the class... (ISI, 2:47)

Judging by her reticence to speak of it and the descriptions she used when she did, Thandi's practicum experience was not entirely positive. Logistical problems seemed unsolvable and the classroom situation not entirely to her taste. Although she found it enjoyable to be off the university campus, it would seem as if Thandi was not comfortable in the classroom, not at ease teaching, and not particularly interested in forming relationships with the learners. Despite the negative tenor of her practica experiences, Thandi does not seem to have been discouraged by them, nor does she seem to have learnt to modify her own classroom practice in any way.

### ***Influence of her view of mathematics***

Thandi's view of mathematics reveals a link in her thinking between numbers and real life: "It's the study of numbers, using numbers to describe um, things that happen in real life, ja to make sense of them but then using numbers" (SSI, 5:6). She believes that mathematics is not finite: "Uh, I think mathematics is part of science; it changes with time and with discoveries and stuff like that" (SSI, 5:10). Learners need mathematical skills so that they can function effectively as adults; so the purpose of the subject is to teach them these skills: in future careers, learners will need mathematical skills like calculation and precision in measurement. According to Ernest (1988), an instrumentalist view of mathematics implies seeing the subject as "an accumulation of facts, rules and skills to be used in the pursuance of some external end" (p. 2). This description seems to fit Thandi's viewpoint, despite the fact that she acknowledges that "discoveries and stuff like that" do occur in science.

She finds mathematics challenging, however. In fact, she believes it to be "a bit difficult, but...then I like challenges so that's why I took mathematics" (SSI, 5:31). She began enjoying mathematics at high school, but passed with an E symbol. She recognises that she was particularly poor in geometry, but still enjoyed even this aspect of mathematics, because "it gets you thinking, ja, ja" (SSI, 5:43). She recognises the shortcomings in her knowledge of mathematics and explains that she has to research the content before teaching it, "making sure that I know my stuff" (SSI, 5:35). Creativity simply takes too much time, since she sees creativity as synonymous with making manipulatives to help learners to understand concepts.

#### 4.2.3.2 Thandi's PMTI

Thandi has very definite perceptions of what is important and what is not to her as teacher. In explaining her prioritisation of the three aspects of PMTI, she wrote,

Subject specialist is the most important as the other two cannot be carried out without it. Didactics specialist and Pedagogics specialist are at all time[s] integrated into subject specialist. Didactics specialist is more important in mathematics than caring specialist. (Q, 2:68)

By implication, to her the carer role is hardly significant compared to the other two. This seems consistent with her opinion of the psychology modules in the BEd programme inasmuch as these modules deal with understanding of the learner's psyche and the teacher's role in caring for the learner: "...they repeat psychology in third year and it's a lot of work and it's a waste of time, that's just what I would change" (SSI, 2:38). Thandi's mentor teacher described her as principally a Mathematics Specialist, but stated that the other aspects of PMTI were hardly observable in her classroom practice.

#### *Thandi as Mathematics Specialist*

Thandi's lack of confidence in actually working with learners during her practica is confirmed in her description of what she learnt at university about being a Mathematics Specialist:

I should be a subject specialist to be able to teach learners good in school. I should be well equipped with the subject knowledge that I can pass on to my learners. During my practicals I realised that lots of work is required before one goes to teach in schools like learning what learners should be taught.(Q, 2:72)

Nevertheless, she places Mathematics Specialist first in her ranking exercise. It would seem that she holds to the belief that knowledge of the subject is the key to successful teaching, but acknowledges that she is lacking in this area. Thandi herself is the first to admit that she is not a Mathematics Specialist yet, although she believes this aspect of being a teacher to be of paramount importance:

Ok, I see myself as...ok, I can see a good mathematics teacher because I'm still learning mathematics, I'm not a specialist. Sometimes when you know much about a subject you tend to forget about the learners you're teaching, like they know less, so you tend to jump some stuff. So now I can say I'll be a good mathematics teacher because I have to learn everything and then go to

the learners and then present the lesson and I know where I maybe find the chapter difficult and stuff. Then I go to learners and when I explain I know which parts are difficult and stuff. (ISI, 2:22)

The fact that she herself does not find doing mathematics easy, she believes, makes her a potentially better teacher, because she will know, from personal experience, what are the “difficult parts”.

### *Thandi as teaching-and-learning specialist*

Although she placed this specialisation second in the ranking exercise, her description of what she had learnt during her tertiary training regarding being a Teaching-and-learning Specialist, gave very little insight into what her actual beliefs in this area are: “The process of learning is the most important when it is accompanied by evaluation of both learners’ work and the process as a whole” (Q, 2:74). She made no mention of teaching strategies or methods which she thought useful in teaching mathematics. In fact, she says she finds linking mathematics to the real world to be problematic, despite the fact that mathematics as a subject appears to be connected to the real world in her view of the subject itself:

So then as a mathematics teacher...I’m more focused on the learner grasping the concept than bringing in the real life situations because in some parts of the mathematics syllabus you cannot bring in... well you can, but it’s difficult to bring in the real life situations and then connect with learners in other levels, like their social. (ISI, 2:18)

In her initial interview she describes belief that, as a teaching-and-learning specialist, she should recognise the diversity of the classroom:

As a teaching specialist, I make sure that I have all my...everything that I’ll need to teach, like all the information and stuff, I’m always up to date with everything. I make sure that when I communicate to learners that they understand and then when I teach I use various methods to explain one concept so that all the learners will understand. I cater for learners who learn first by listening [and] by speaking or doing something, to just include everyone. (ISI, 2:28)

In this statement Thandi reveals what her understanding is of what knowing how to teach means: it means having “all the information and stuff” and always “being up to date with everything”. She attached value to education theory – not its application to the real world of her classroom. Thandi also believes that the university helped her to develop her own teaching style, which she described as “more practical”, because, she explained, she would demonstrate verbally and then allow the learners



to “do”. She learnt the theory of teaching at university, but when in the classroom, she rejected both university training and modelling by her mentor teacher in favour of her own style, developed according to her perception of what the learners need.

INTERVIEWER: So would you say the university influenced you to develop your own style?

THANDI: Yes ma’am.

INTERVIEWER: Ok, how?

THANDI: Ok, from teaching methodologies, and then that’s where I learnt most of the stuff and then also from the practicals because we go there and then we go to real life situations and then that’s when you have to be creative to see how you get learners to understand stuff like that because um, you can see the other teacher doing...teaching in this other way and then when you try it and then it won’t work for you. And then, so you have to develop your own way of teaching that the learners would understand, ja. (SSI, 5:116)

The “two-worlds” dilemma (Feiman-Nemser & Buchmann, 1987) is noticeable in Thandi’s explanation. She acquired the theory for teaching during the course of the teaching methodologies presented in her Third year, but was then confronted with the reality of the classroom and the mentor teacher’s way of doing things. Ultimately she had to develop her own style, because what she was taught and what she observed did not, apparently, work for Thandi.

### ***Thandi as Carer***

Once again, it would seem that Thandi knows the *theory* of what is expected or required of a good teacher in this regard. In her initial interview she stated,

As a teacher, one of my roles is a pastoral role so when a learner has a problem in my class, obviously that learner will not be able to learn so I’ll have to talk to a learner, maybe after the lesson or during break or whenever they have time and if they’re feeling...they’re opening up to me, they will talk to me if they trust me and I have to keep the information confidential so that they can trust me and then we can talk about their problems and stuff. (ISI, 2:24)

Judging by this statement, Thandi seems to believe that being a Carer is a role she would play in a one-on-one counselling situation. She does not appear to connect this role with caring or caring behaviour within the classroom situation. However, in her succinct description of what she learnt in

this regard in Section 2 of the questionnaire, she wrote, “It is part of every teacher in each and every learning area, even mathematics. Learners are made up of their social space/world” (Q, 2:77)

Even in discussing the practical outworking of her beliefs in terms of this characteristic of PMTI, her answer is theoretical:

Ok, as a social specialist, every day when I go to a class then I greet the class and they see that everyone is ok. And if someone is just sleeping in my class I’ll want to know what’s wrong with the learner so that I will be able to continue with the lesson because I can’t just let someone sleep in my class and maybe that someone is dying and I’ll be responsible and stuff like that. (ISI, 2:28)

Thandi does not link caring with the actual individual learner who may be experiencing difficulties in his life. Her understanding of the pastoral role appears to be theoretical and not part of who she actually is as an educator.

#### **4.2.3.3 Actualisation of Thandi’s PMTI**

Thandi’s confidence in herself as mathematics teacher is translated into the classroom as an aloofness from the learners. She speaks of subject specialisation as of paramount importance, and demonstrates in class that the subject matter is indeed what she attaches most value to. However, her presentation of the topic was not without flaws and mathematical inaccuracies.

##### ***Mathematical expertise***

Despite Thandi’s firmly held belief that knowledge of the subject is the panacea for all the ills of the classroom, and despite the fact that her mentor teacher testified to her mastering of the subject matter, the observed lessons were, in the words of the mentor teacher who was present throughout, not successful. Nevertheless, he did find that she was able to explain concepts and accompanying skills:

For the short time I’ve been with her I noticed in her a good mastering of the subject matter; knowledge and skills so far as the explanation is concerned and with little integration of the subject matter to other aspects of life. (Mentor Teacher questionnaire)

The mentor teacher did, however, find it necessary to call Thandi over during a point in the lesson where she had learners writing their calculations on the board. Two of the learners made glaring

errors which slipped Thandi's notice, and the mentor teacher was forced to point these errors out to her and to ask her to correct them.

Thandi believes being a Mathematics Specialist is more important than any other aspect of PMTI; and she believes, more than that, she knows, that her subject knowledge is, as yet, insufficient for the task of teaching successfully. Her awareness of her lack of knowledge is evidenced in her determination to find out about the topic she is about to teach by researching it in a variety of textbooks.

### ***Teaching and learning***

During the lessons that were observed and recorded, Thandi did not use different methods to explain the actual mathematics. However, instead of just telling the learners what the possible applications could be for the kind of trigonometry she is introducing them to, Thandi encourages them to consider for themselves the problems of measuring distances that are very large. So she asks them how they would measure the height of a table; the height of the building over the road; the distance to the moon. Unfortunately, the level of noise outside her classroom was such that it was almost impossible to hear what she was saying. Asked why she used this approach, Thandi explained that she wanted them to reflect on the knowledge they had of measurement and then to realise that it was insufficient for the problem she set them. She was able to demonstrate how useful trigonometric means were to calculate such distances. Thandi does not recognise this as being a creative strategy – she simply wanted them to think. She believes that for understanding to be achieved, the concept being taught needs to be made relevant to real life. Her determination to carry out this particular strategy seems to be firmly embedded in her teaching style, according to this statement she made in her initial interview:

The thing with mathematics...for a student to understand you need to bring in the real life situations into the classrooms. Some mathematics teachers, they deal with the mathematics problems in isolation with the real life situations and still they tend to forget that learners don't think that mathematics is related to them in some real life situations. So I'll say a good mathematics teacher is someone who is capable of relating mathematics to the real life situations. (ISI, 2:7)

Nevertheless, she does not find this easy. In analysing the video footage of her teaching, it becomes clear that Thandi's awkwardness in the classroom is not a matter for conjecture. Her lesson is characterised by long uncomfortable pauses where she says nothing, makes no eye contact with the learners and enters into no interaction with the class at all. During some of these pauses she quickly looks into her file or textbook to find prompts for the next few moments of teaching time.

### **Evidence of understanding**

Thandi's teaching style is characterised by frequent long pauses in which she silently looks at the class while they look at her. Her intention with these pauses was visual assessment: "I look at the learners and then I read their faces if they understand, they're with me or if they're just lost and then I...I just read their facial expressions" (SSI, 5:71). However, the length and frequency of the pauses, as admitted by Thandi herself, are awkward. In fact, to an observer it seems that Thandi's pauses are more indicative of uncertainty than anything else. When asked what she found most striking in the footage of herself teaching, she quite emphatically identified these pauses:

INTERVIEWER: What would you say is really...what stands out in that video? What strikes you?

THANDI: The waiting...

INTERVIEWER: All the pauses.

THANDI: Yes, yes the pauses, yes.

INTERVIEWER: Haha, why? Why does it strike you?

THANDI: No, they take like...I take time.

INTERVIEWER: Perhaps too long?

THANDI: Ja, I take a lot of time, ja. (SSI, 5:125)

About a third of each lesson is spent walking around the class looking at learners' books and talking to learners here and there. Thandi finds this useful in determining whether the learners have understood the content or not. She explained that "cross-questioning" the learners, or asking them to "explain back" provides her with evidence of understanding:

INTERVIEWER: Alright, let's look here. Now here you are dealing with an individual learner. Now what are you doing when you bend over a desk and talk to a learner? What are you doing?

THANDI: Ok, if I notice mistakes and then and even where they...they've done the sum like correctly and then I give comments and then I help the learner get to an answer. I don't like I leave the learner, I don't need to give the learner the answer and then I will come back later and then check the answer if it's correct.

INTERVIEWER: Now do you believe in walking around the class and looking at their books during a lesson?

THANDI: Yes, if you're done with the lesson. (SSI, 5:81)

### **Teacher/Learner-centeredness**

Approximately one third of each of Thandi's lessons is devoted to learner-teaching – she invites various learners to come to the front of the class to explain sums that they have done, because she believes learners learn best this way:

Ok because, ok I believe like by...with me like standing in front of the classroom and then giving learners everything, it is best if I just give them examples and then I let them come and then they...they try to solve the problems themselves, rather than me solving the problem for them. (SSI, 5:95)

While this is happening, Thandi stands to at the side of the class and watches the learners, both the one at the board and the class in general. She does not, however, monitor what the learner is writing or saying. The result is that mistakes slip by unnoticed. Thandi explains why she nevertheless considers this strategy to be successful: “sometimes other learners they learn best when they hear stuff from their fellow...fellow learners, ja. That's why I do that” (SSI, 5:79). Her belief in this particular technique was founded in the teaching practicum during her Third Year: “That was teaching for me and then from last year, and then that's when I developed my own way of teaching, ja” (SSI, 5:115).

In observing her teach, it can be seen that Thandi is not at ease with the process of teaching. She is frequently at a loss for words and often seems unsure of what to do next. This possibly explains why she favoured the strategy of allowing learners to come to the board to show how they did the exercises and to explain how they arrived at the answers. At one time another learner asked a question which Thandi, unwilling or unable to answer, allowed the learner at the board to answer and

explain. It would seem that she expects her learners to be compliant, accepting what she says without asking questions. It may thus be that Thandi believes that allowing a learner to take over the lesson for all intents and purposes, is in fact a viable strategy for her as currently inexpert and inexperienced teacher.

### **Flexibility**

The order of activities in her classroom is a result of planning, she explained. That is what planning is for: “So if you’re planning a lesson and then you know, I’m going to do this first and then this second and this last. Ja, then it will be much easier and then you connect the outcomes” (SSI, 5:187). However, further “research” was also apparently important in Thandi’s lesson planning, since this enabled her to stay ahead of the learners in terms of content knowledge and to maintain her confidence in herself: “Ok, I’m sure that I know the stuff and that I’m confident, ja. And then what I’m not sure of is that the learners understand, ja, that’s what I’m not sure of” (SSI, 5:211). However, she was taught at university about being a reflective practitioner, so she tries to improve on her choice of examples to illustrate a concept if it seems as if a particular class did not really understand what she was trying to convey to them.

She does not allow learners to pursue a line of questioning which has not formed part of her pre-lesson research. When a learner does ask such a question she either ignores it, or asks the learner at the board to deal with it. Her planning and limited content knowledge therefore entrenches her inflexibility in teaching, because her lack of subject knowledge does not allow her to deviate from her planning.

### **Evidence and purpose of caring**

While walking around the class, Thandi bends over the learners’ desks and communicates with them in a way that appears friendly and unthreatening. She explained that she has a very particular reason for using this approach:

Yes ma’am, because uh, one of the problems with learners uh, who have like difficulty in learning and stuff ... is that they are scared to ask questions. Ja, so if you are not approachable they won’t ask questions and then if you come to that desk and then they will try to hide their work because they are scared you’re going to make some comment which they won’t like and stuff. (SSI, 5:91)

Therefore what appears to be a caring attitude is in fact based on a purely academic exigency – Thandi needs to see their work – and not on a particular concern for their personal wellbeing at that time. She corroborates this with her answer when asked whether she believes in building relationships with the learners: “No, I don’t. No, I don’t, just be professional and approachable and then learners will be able to approach you and then relationships, no” (SSI, 5:155). She explained that building relationships with learners, according to her, leads to problems of favouritism. She also believes that her availability after school is only valid if learners arrange to come in groups. If individuals require assistance, that must happen during class time:

Uh the thing is uh, during...in class like you can be able to help uh, learners individually but then after school you’re taking your time and then the learners time so it will be very nice if they come in groups and then you’re helping more than one learner at a time. (SSI, 5:259)

In observing Thandi teach, it was noticeable that her interaction with learners in the class was stilted and confined only to answering formally posed questions, that is, questions posed by a learner whose hand is raised. She does not react to inchoate murmurings of the class when something she has taught is not clearly understood. Her mentor teacher, in the informal interview he agreed to subsequent to the lesson observations, declared that the single greatest shortcoming he could identify in the classroom practice of this student was that she had no rapport with the learners.

Both Thandi and her mentor teacher stated that caring plays almost no role in her current practice. This student, while admitting the necessity of caring being part of the PMTI of a teacher, at this point attaches little value to its importance. She is cognisant of the theory underlying this characteristic of teacher identity, but is not currently concerned with its practical outworking in the lessons she teaches.

#### **4.2.3.4 Summary**

Thandi demonstrates with her academic results that she is a conscientious student, but that her knowledge of mathematics is adequate rather than good. At school she just managed to pass the subject, despite the fact that she loved the challenge it offered. Her personal background offers few clues as to PMTI influencers, other than the fact that she was educated in a private school in an entirely black community, where it would seem the notion of being a mathematics teacher having a

good standing was engendered. Together with the belief that being a mathematics teacher makes one *somebody*, comes the conviction that one therefore has the power “to change things”. In Figure 7 this influencer is represented with a large arrow block, as is the tertiary environment. She experienced tertiary training as positive and life-changing in that she acquired knowledge of the theory of teaching – that it is not just about passing on knowledge, but also about facilitating learning. She regards modules concerning the psyche and emotions of the learners to have been a waste of time, however. This is significant: Thandi demonstrates in her teaching that she has no desire to become involved in professional relationships with her learners- she holds herself distant and aloof from them. Her lack of interest in the educational psychology modules therefore demonstrates a deep-seated disinterest which continues into her classroom practice. In the figure below, the influencing strength of her view of mathematics is presented as a slightly stronger influence than the teaching practica, since it seems as if her view of the subject is more dominant as an influencer of her PMTI. Thandi seems to see mathematics as a series of skills and facts which are useful in the real world – they can be learnt if one listens and works hard. In this she seems to be an Instructor in her intention to impart these skills to her learners.

This a student whose knowledge of mathematics in terms of what is required to be taught at high school, is lacking. She is aware of this inasmuch as she tries to read up on what she is about to teach in various textbooks. Although she states that she loves mathematics and that she finds the subject difficult, she considers herself to be a good mathematics teacher. She reasons that the fact that she has to learn the work alongside of her learners, makes her a better teacher. She prides herself on her knowledge of education theory and the fact that she is always “up to date with everything”, but seems to make almost no connection between theory and her own classroom practice, which she developed without reference to either her tertiary training or her mentor teacher’s guidance. She describes her teaching style as practical, based on the fact that she lets her learners work in class on the concept she has taught. She is hampered in her teaching by this lack of expertise, despite her careful planning. Nevertheless, she tries to bring the learners to an enjoyment of the subject by leading them to link it to the real world and by trying to appear friendly. In Figure 7, Thandi’s PMTI is presented as having a dominant Mathematics Specialist aspect, with a smaller Teaching-and-learning aspect, and an even less significant Carer one.



In terms of Ernest's categories, she is an instructor. Perhaps the most outstanding feature of her PMTI and its actualisation is her total lack of rapport with her learners, despite her theoretical consciousness of the necessity of the pastoral role in a good teacher's classroom practice. There appears to be no conflict between what Thandi understands to be a good mathematics teacher and her own practice: she believes herself to be a good teacher despite lacking in every one of the three aspects of PMTI. She believes her teaching to be learner-centred – she allows learners to teach; she thinks her lessons are thoroughly planned and that she “know[s] the stuff” despite the long awkward pauses in her lessons while she consults her file; she sees herself as a good teacher because she does *not* know the mathematics involved; she perceives herself as available and approachable to her learners, yet she holds herself aloof from them, declaring unequivocally that she is against relationships with her learners.

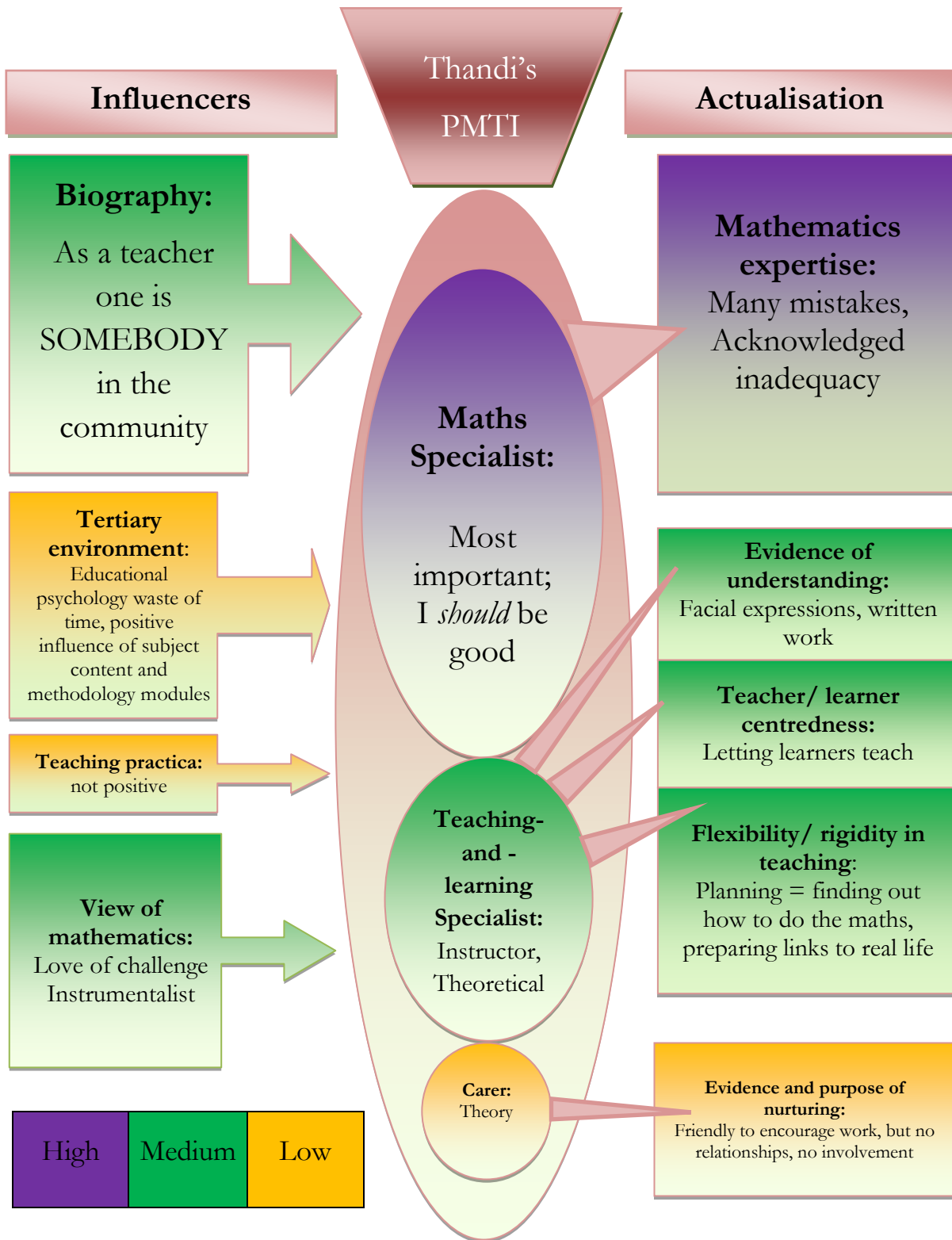


Figure 7. Thandi's PMTI according to the Conceptual Framework

## 4.2.4 Thabo

Thabo completed his schooling in a large, disadvantaged, rural school, where he stood out as one of the few who did well in mathematics, achieving a C symbol (60-70%) at the end of Grade 12. He had to wait three years to qualify for a bursary before he could enrol for a BEd at UP. At university he proved himself to be a good student, achieving consistently pleasing marks throughout his studies with a final overall average of 66%. For mathematics his average was 68%. During university holidays he returned home to teach extra mathematics classes at his old school.

### 4.2.4.1 Influencers

#### *Biographical factors*

Thabo attributed the beginning of the notion to become a mathematics teacher to the influence of his high schooling. He certainly did not believe that his career choice was in any way influenced by friends or family, or that his conception of what it would mean to be a mathematics teacher was linked to any personal influence other than his own schooling. In the interview, Thabo explained where his conception of himself as a teacher of mathematics began:

It started back in...when I was doing Grade 9, I was used as a substitute for the teacher back at home because she was taken to the staffroom to be a clerk. So she used to call me in the mornings and she would teach me and then thereafter she would say I must go to the class and teach the learners and then give them the homework and mark the homework that was given yesterday. So it started there and then. That's when I had the passion for the teaching. (ISI, 6:32)

Not only did the opportunities to teach while still a learner establish the idea of becoming a teacher in his mind, but they birthed within him “the *passion* for teaching”. Asked why he was selected from amongst all the learners in his class, he replied, “Now maybe it's because she was aware that I was doing well in this thing [mathematics]” (ISI, 6:40). Therefore his own mathematical prowess was the determining factor in the decision of his teacher to make him the surrogate teacher, but in his analysis of this situation Thabo did not directly link his passion for teaching to this prowess - instead he linked it to the experience of actually being a teacher. He emphasised the pleasure teaching gave him: “Yes, I enjoyed teaching the class!” (ISI, 6:44)

### ***Influence of the tertiary environment***

Thabo expressed only strong approbation of everything related to his tertiary training. Since Thabo began his tertiary studies having more teaching experience than most students, he thought the actual teaching was what one did instinctively and that his studies would serve only to augment his subject knowledge:

THABO: Truly speaking, I just thought that because I wanted to do mathematics, I thought maybe we'll only deal with mathematics general modules...the majors like physics, general science, and computer technology. I never thought that there were modules related like JPS [Professional Studies] or OPV [Education] and other modules that teach you *how to*...the teaching strategies in the classroom. So I just thought that we'll do mathematics over and over again so that we can be knowledgeable...so that we can teach.

INTERVIEWER: Ok, so you were surprised?

THABO: Yes, I was surprised.

INTERVIEWER: And did you think that it was a good idea to have those modules?

THABO: Yes, it's a good idea.

INTERVIEWER: Have you learnt?

THABO: Yes, I have learnt a lot. (ISI, 6:76)

He experienced his studies as something of a revelation, since he did not know that there was more to teaching than what he already knew and had learnt by copying his teacher. He had not been aware that strategies exist in which one can not only recognise diversity on the classroom, but that diversity can be accommodated:

In Grade 9...so in Grade 9 I was just teaching like that, I meant [like] the teacher, the class teacher. Because I was the head of teaching and then I thought that's the right way of teaching. But when I came here, I've seen that this is not the right way of teaching and then I must try to vary the teaching strategies in order to accommodate all of the learners in the classroom. (ISI, 6:92)

In his initial interview, Thabo confirmed his appreciation of the modules which he completed at university. His approach to his studies appears to have been a very practical one: he absorbed into his understanding that which his experience had taught him would be useful when standing in front of a class. "All the things we've done up to so far, according to me they are useful. When going to school

and having done all those things that we have learnt here, I don't experience a lot of problems" (ISI, 6:104). The criterion for sense-making of the theory he was learning seems to have been that it be useful in the enhancement of his practice. This is demonstrated by his account of the usefulness of strategies he learnt in his methodology module:

THABO: ...Methodology has been very useful also because we have discussed a lot of things that I never knew before. Like for instance, I can give you an example, with the manipulatives... So I've once tried to use manipulatives because we were doing the properties of quadrilaterals. So we used the manipulatives and it was, the learners find it very interesting.

INTERVIEWER: What did you use specifically? Did you have pictures that you cut out, or what?

THABO: No, for example, if we have...about the diagonals of the rectangles, if you fold a rectangle like this and then that side ..[demonstration]. To see that...the diagonals of the rectangles bisected...

INTERVIEWER: They fall on each other, yes. And do you find that the learners could understand better?

THABO: Yes. We also used the diagonals of a cone for the surface area and the volume because we had a tin of coffee and then we cut out the paper and then make sure that the paper is of the same radius as that tin and then we made a cone out of that to show the volume. And then we used some sugar to pour the sugar in that cone, that if we pour it three times into that...

INTERVIEWER: Into the tin...

THABO: Into the tin, and then it means the volume of a cone is a third of the cylinder. (ISI, 6:126)

It therefore seems that Thabo made sense of the information he received as a BEd student by considering its usefulness in view of what he already knew about the exigencies of teaching mathematics. There is a sense of wonderment in the way he speaks of his university experiences – as if his tertiary training has been a very positive experience. Thabo feels that he has grown as a person and as a teacher through the addition of theory he never knew existed, but immediately recognised the value of.

### ***The influence of teaching practica***

Just as he saw his theoretical training as useful and learnt from it everything that he thought would make him a better teacher, so Thabo dealt with the teaching practica. For him they were not so much

opportunities to practice as they were opportunities to learn. The one thing he determined not to do was to teach as he was taught at school.

His overall assessment of the teaching practicum is a very positive one. In fact, in his initial interview, Thabo spoke of his approach to teaching practica: he would observe the mentor teacher carefully and follow their example, but where possible or necessary he would include what he had learnt at university: “Firstly, I watched the classroom practice of my mentor teachers and then I followed their procedures but adding to that is what I’ve learnt from the university in JPS and other modules” (ISI, 6:112). In other words, he was able to apply relevant theory to add to the classroom practice he was observing. However, it would seem that the mentor teachers’ classroom practice was sometimes inefficient. Thabo, assessing this, was able to draw from his new-found theoretical know-how to ameliorate his learning experience as a student teacher: “But mostly I would, I like to look at the classroom practice of the mentor teachers and then I improve right then and there with whatever is being taught here at the university” (ISI, 6:64).

### ***Influence of his view of mathematics***

When asked to describe the subject as if to someone who knew nothing about it, Thabo spoke of mathematics as “a science of numbers” which would help learners to solve real-life problems, “Uh, especially when coming to geometry. Uh, the reasoning capacity of the students... would be able to increase if they...they...they master the concept, the geometry” (SSI, 4:7). Not only does Thabo not see mathematics as a closed system, but he is also very much aware of the inadequacy of his knowledge of so vast a system – he does not even believe that he knows enough about it to teach the subject efficiently: “So I need to be a lifelong learner in a way that I...I...I still have to learn more on...on...on other topics so that I can be a good teacher” (SSI, 4:9). He came to believe that this was necessary during the period of three years after he matriculated and before he was able to obtain a bursary for tertiary study. During this time his matric mathematics teacher encouraged him to do assignments about topics that he had to study on his own, and to help Grade 12 learners who were experiencing difficulties with their school work. This forced self-study showed him the value of “being in mathematics” and finding out for himself how much he did *not* know.

Because he sees mathematics as part of science, Thabo believes that the discipline is constantly able to “update people about what is...what is happening around and then, uh, ...if they...they...they master mathematics then they’ll be able to conquer any obstacles that are there in life” (SSI, 4:37), which is, according to Thabo, its purpose. In terms of Ernest’s (1988) model, Thabo’s view of mathematics is Problem-solving. He sees mathematical problems as challenges which need to be conquered. He recounts an anecdote of when he was in Grade 12 and he and other friends would work as a study group – “[they] would advise me not to spend too much time on one problem because... I didn’t like *not* to find the solution to the problem and then I would spend *more* ...on the problem until I find the solution...” (SSI, 4:41). He explained that the tenacity required to grapple with mathematical problems “made me to like mathematics, so I like mathematics.”

#### 4.2.4.2 Thabo’s PMTI

When asked how he would describe himself as a mathematics teacher, Thabo said:

Ok, myself as a mathematics teacher, I can say I’m a caring person and I have the time to listen to learners and I’m also approachable. Whenever they come to me and they ask me questions and then I’ll...even after school I’ll make time for them so that I can help them with those problems. If I’m not able to help them at that time, I’ll promise them that when I go home I’ll find information about that and then when I meet them again I’ll explain it to them. (ISI, 6:48)

Thabo’s mentor teacher confirmed that this is true:

He is excellent and then, you know, I wish all the students could be like him. He loves his job, he prepares, you know he focused at the learners more than himself. He goes an extra mile, sometimes he organises some afternoon classes with them. You see, he’s got the potential.

#### *Thabo as Mathematics Specialist*

In the ranking exercise of the questionnaire, Thabo stated that being a subject specialist and being a didactics specialist were exactly equal in his PMTI. Judging by this statement, Thabo believes that Mathematics Specialisation without Teaching-and-learning Specialisation and vice versa do not make for good teaching. He elaborated on this by writing, “It is important to know or to have subject knowledge in order to be able to deliver it to your learners. It will be easy for me to teach if I have a sound knowledge of the subject” (Q, 2:124). To him, subject knowledge is therefore directly linked to making teaching easier. Asked whether he felt he knew his subject in the initial interview, Thabo’s

answer was an unhesitating “Yes” which seems to contradict his earlier statement that he felt he had much to learn about the subject. Possibly the certainty with which he answered about knowing ‘his subject’ referred to the topics that are taught in school rather than mathematics as a discipline.

### *Thabo as teaching-and-learning specialist*

When Thabo was asked in his initial interview to describe his idea of a good mathematics teacher, he declared,

I would say the good math teacher is the one who is always well prepared and is willing to help the learners, even if they ask for extra classes, he must be there at all times. So he must help the learners and always be prepared. (ISI, 6:28)

Therefore it seems as if Thabo complies with his own requirements for being a good teacher. Implicit in these requirements is the subject knowledge of such a teacher, who is “always prepared”. His emphasis is on being available to the learners, ready to do what is necessary to help them in every possible way.

Creativity in presenting certain topics is not a problem, according to Thabo:

Uh, I would say like geometry, geometry can be creative using manipulatives and then using the posters and stuff. But then when coming to concepts like uh, ... like financial mathematics, I don’t see how...how one can be creative with that. (SSI, 4:57)

However, it is important to him that lessons are made interesting. Following the teaching style of his teacher while he was in Grade 9 was boring, Thabo declared. He even found it boring when, himself a Grade 9 learner, he was obliged to teach that way because he had no experience of any other teaching style. The lessons followed this pattern:

You’ll firstly start by writing the topic on the board and then from there maybe you make about three examples and then after making those three examples, obviously, the formula...you’ll give them the homework and that is from the textbook. And then the homework that was used, the textbook... (ISI, 6:140)

He explained this more fully when asked why he thought change in this pattern was necessary:

Sometimes when, especially when going to rural schools you’ll see most of the teachers are still using the traditional way of teaching. And then when I add this [didactical expertise acquired at



university], I try to involve the learners in the process because sometimes they [rural school teachers] will teach from the beginning of the period up until the end of the period. (ISI, 6:68)

Therefore, Thabo's first "entries" into his understanding of good mathematics teaching were of the how-not-to-teach type. It was only upon working through the BEd course that he acquired knowledge regarding alternative methods: the how-it-should-be-done know-how. Here he learnt that teaching from the beginning to the end of the lesson was not necessarily successful, and that this teacher-centeredness has in fact been supplanted by a learner-centred approach, which, he says, makes more sense to him: "I prefer involving the learners because I believe if they're involved in the lesson they learn more than when they're just listening" (ISI, 6:72).

### ***Thabo as Carer***

Both Thabo and his mentor teacher recognised the caring aspect of being a teacher as distinctly lower in priority in his PMTI than the other two aspects. This is accounted for in Thabo's explanation:

I focus more on the subject knowledge and skills. Learners must know the subject. I am also more on the preparation and implementation and evaluation of the teaching and learning process... I lack the skills on socio-emotional and development of learners. (Q, 1:120)

#### **4.2.4.3 Actualisation of Thabo's PMTI**

Thabo is a serious young man, an authority on what he is teaching, and yet approachable in his attitude. He was seen to be able to gain and keep the attention of the whole class throughout the lessons.

### ***Mathematical expertise***

Analysis of the video footage of his teaching shows that at no point in his teaching does he err or hesitate, nor does he refer to any notes or text books while expounding on the topic. His presentation is smooth, considered and well-prepared. Thabo's mentor teacher wrote the following, expressing his approbation of Thabo's subject knowledge, but pointing out the danger in running ahead with that knowledge:

Thabo knows the subject mathematics very well. He can be good to lecture the university students ... He is good in teaching, but leaves the learner behind. Learners must be included, even those who

are very slow in comprehension. He must give more time to learners to respond. (Mentor Teacher questionnaire)

It would seem that Thabo's own confident handling of the subject matter precludes him from always noticing when the learners do not share that confidence. However, there are certain topics about which Thabo lacks confidence:

There are certain topics that uh, I'm able to go in the classroom and then I can present them, even without preparing. But then there are topics like uh, probability, mostly probability it needs me to prepare more before I go to a class because now, uh, I don't...and I'm scared of...I'm scared of uh, not explaining fully the concepts to the learners... (SSI, 4:225)

These topics are the ones which were not part of the curriculum when he was a school learner himself, and although they were dealt with to some extent at university, he is not as sure of them as of those that he understood as a learner. For example, he spoke of "a very good teacher who was good at linear programming" who taught him so thoroughly while he was at school that when he was required to teach linear programming during his teaching practicum, "I didn't experience, uh, too much problems because I, uh, I remembered what that...I still remember the work that we have done in grade 12" (SSI, 4:13). Nevertheless, with thorough preparation he is able to compensate for a lack of confidence in teaching new topics in such a way that the learners in his class are aware of no difference.

### ***Teaching and Learning***

Thabo does not believe himself to be a teaching-and-learning expert, however, despite the developments that have been effected in his PMTI in this regard. He believes he has acquired skills and knowledge in preparation, implementation and evaluation of the teaching and learning process. Nevertheless, he is fully conscious of shortcomings in his teaching skills and the need for further research in this area:

INTERVIEWER: Ok, and at this point, although you're not experienced, do you feel you know how to teach mathematics?

THABO: No, I'm still willing to learn more. (ISI, 6:58)

One of the strategies which Thabo made use of in the observation lessons was relating the specific mathematics topic to the real world in an attempt to anchor the new knowledge he was imparting to the learners in their own frame of reference. In the video, Thabo is seen to be drawing graphs on the board with painstaking precision. He does not believe in rough sketches – he drew the axes and marked them with a board ruler; he drew the graphs by linking dots he made on the Cartesian plane. He was also determined that the learners should not just see the graphs about which he is teaching them as precise lines drawn on a board, but that they should also be able to link them to the real world.

To this end, he explained about hyperbolae being used to make lenses, and he explained, using the overhead projector, how these graphs could be used in lens design, analysis of capillary forces and rainbows, and the location of ships at sea prior to the use of global positioning systems. The learners showed interest in his explanations, but it was clear from the blankly puzzled looks on many faces that the idea of ship location was beyond their understanding. Although the real-world applications were entirely correct and accurate, it seemed that Thabo had misjudged the level of application which would make this topic relevant to the particular set of learners in front of him. When asked about the appropriateness of this example, Thabo answered as follows:

INTERVIEWER: Do you believe that they understood what you meant about hyperbola being used for lenses?

THABO: I don't think they... they...they understood what uh, hyperbola was used for lenses. But then, uh, I thought that it might be important that they... they, that they need to know how is it used in...in...in...in other things or in real life situations. (SSI, 4:63)

Thabo therefore prioritised making the lesson relevant to the real world above making it relevant to the learners in front of him. This corroborates the statement made by his mentor teacher that Thabo pitches his presentation above the level of his learners.

Nevertheless, he says he has learnt that, in order to teach mathematics efficiently, it is necessary to take classroom diversity into account. In his initial interview he explained this, but without indicating that he had a very clear idea of what such strategies would entail: “But when I came here, I've seen

that this [what he saw at his old school] is not the right way of teaching and then I must try to vary the teaching strategies in order to accommodate all of the learners in the classroom” (ISI, 6:92).

In his reflections upon what made for good teaching during his teaching practicum, Thabo also compared teaching suggestions from the university with those from his mentor teacher and found that what the mentor teacher told him to do did not work quite as well:

My mentor teacher used to say that we must teach uh, from the focal point, we must stand in front where every learner is seeing you and then for the rest of...for...for...for the rest of the period you have to stand there. And then I found that to be giving me problems because I wouldn't...I wouldn't uh, be able to control the class because those that are at the back, they will start disrupting the class... He was against uh, the...he was against that thing that you must move up and down in the classrooms so that you can control all the learners there. So, for that one I...I...I...I...I weighed the [the suggestion] from the university that you must move along [the rows] and then see how...and then [I am]... able to control all the learners in the classroom. (SSI, 4:309)

### **Evidence of understanding**

Asked how he determines whether his learners have understood, Thabo said that his strategy of preference was observation of body language:

THABO: Hmm, it's...it's through, I would say it's through observation because when I observe them uh, you will see that when...when they're enjoying the lesson uh, they would even ask them uh...uh...uh, one would even ask uh, his or her friend about uh, that or to ensure that maybe his or her friend is understanding that and then the excitement, also the excitement in the classroom would show you that they're they...they...they do understand the concept, they have grasped the concept.

INTERVIEWER: Ok, let me ask the question slightly differently. How...what evidence do you see or do you look for that the children are *not* understanding?

THABO: Hmm, it's mostly when...when they give you that look, that weird look. Sometimes they would be quiet and look, uh, look at you in...in a way that you'd see that they don't even understand what you are saying.

INTERVIEWER: You look at their body language.

THABO: Yes. (SSI, 4:181)

At the same time, Thabo believes that it is important that the learners are with him every step of the way. For this reason he frequently invites their participation by asking questions to be answered by individuals. Observation of the videos shows that he often allows minimal time to lapse after he has posed to a question, and gives the answer himself before the learners have had sufficient time to compose an answer:

INTERVIEWER: Do you believe that there was enough time to...for the learners to think carefully about what you'd asked them?

THABO: No, it...it...it was not enough time and uh, I've realised that in most cases uh, that is my problem because I don't give learners enough... enough time to think about what I've asked them. So I should work on that so...so that I can give them more time to think about it before I can explain that.

INTERVIEWER: Do you believe that it is important for learners to participate in the lesson like that?

THABO: It's very important.

INTERVIEWER: Why?

THABO: Uh, when you learn on your own it's better than when you... when you are told. (SSI, 4:71)

It would seem then that Thabo's motivation for asking questions and involving the learners is based on the belief that they need to be thinking for themselves about the content of the lesson. However, in his execution of this strategy he fails to achieve his own goals, because he answers his own questions before the learners have had a chance to do so. Asked why he believed that it is important for learners to make sense of the work themselves, he explained that at his high school the mathematics class was divided into three study groups which competed fiercely for the best results. The groups were encouraged to learn on their own so that they would not be defeated in the competition. He would have preferred, he said, to allow the learners to puzzle about the work until they arrived at a solution, but he found that they were unable to finish the activities in class time, and did not do their homework, therefore, if he wanted the lesson to be completed in time, he would have to answer the question and supply the solutions himself. Theoretically however, he believes, "So, you must...you must encourage [the learners] to...to be critical thinkers, I think" (SSI, 4:113).

However, he tends to overestimate the level of understanding of his learners, sometimes directing his explanations above their heads. His mentor teacher observed the same thing:

MENTOR TEACHER: What I can say, what I've observed about him, he's beyond the comprehension of the learners so if he can give them more chance to...for responding and asking questions now. They do understand but we don't know how many are left behind.

INTERVIEWER: So his level is a bit high.

MENTOR TEACHER: It is a bit high, it is a bit high, he's going to be a lecturer one day. Ja, that's true, I won't mind to be...

INTERVIEWER: A student of his?

MENTOR TEACHER: Ja. (Mentor teacher interview, 1:12)

### **Teacher/Learner-centeredness**

Thabo's mentor teacher during the long practicum of the Fourth Year, was a man with over thirty years of experience teaching mathematics. He recognised Thabo's potential and was quick to say so in the interview held with him. He saw that Thabo was different from the other student teachers he had mentored:

INTERVIEWER: ...From what you've observed, what really stands out?

MENTOR TEACHER: From him?

INTERVIEWER I: Yes, from him.

MENTOR TEACHER: The uniqueness, I've been a mentor for so many educators that's why I see [when] people are unique. He's unique in a professional way. (Mentor teacher interview, 1:32)

Part of Thabo's uniqueness seems to lie in his self-effacement: when he is in the classroom, what is on the forefront is not himself, but the subject and the learners. Thabo creates the impression of being a very quiet, serious young man with a naturally unassuming nature.

Nevertheless, Thabo does not allow the learners to do much in the way of discovery on their own. He continually guides their every step, making sure that he is with them at every stage of the lesson. It is clear in his manner that he is driven by the need to have his learners understand and enjoy the

work as he himself does. He, by his own admission, does not have the skills to involve them successfully in such a way as to enhance learning.

### **Flexibility**

Thabo believes he is a reflective practitioner, and is able to recognise that when he teaches a lesson repeatedly it improves with each repetition.

I would feel and see that the first lesson was not so good as the second and then the second was not so good as the third because the second lesson I would adapt and then change there and then because I would have seen my...my...my...my uh, mistakes there and then and try to fix those mistakes. (SSI, 4:249)

Nevertheless, Thabo believes that a lesson plan provides a necessarily rigid structure to a lesson so that order is maintained and distractions do not scuttle the outcomes required of that particular lesson. This, he said, he learnt at university.

Now if you go to the class and then you are unprepared, you haven't planned the lesson, you won't know where to start and then when to give the uh, and then when to give the...the...the activity, when to ask the questions and the stuff. And then sometimes there are learners in the classroom that would always like to challenge you to see whether uh, to see whether you...you...you are knowledgeable in the subject. So, and if they can realise that you are not...you are not so knowledgeable on the top...on that topic, so they will start disrespecting you. So that helps in the classroom management also. (SSI, 4:201)

It would seem therefore, that planning a lesson to the last detail is a strategy Thabo uses to compensate for a lack of experience and/or knowledge. In fact, when asked what would cause him to feel uncertain in the classroom, the only situation he could think of where this would be the case is if he were required to teach a lesson unprepared. Despite his careful planning, he still makes mistakes:

INTERVIEWER: What sort of mistakes do you think do you make?

THABO: Mmmm, sometimes uh, I would forget about the...the...the important concepts that I have to involve in the...in the integration of the lesson. And then...and remember them towards the end of the lesson and then, but uh, as soon as I remember them in the lesson, I would...I would... I would tell the learners about it. (SSI, 4:257)

### **Evidence and purpose of caring**

According to Thabo's belief system, caring should take the form of encouragement. He believes that poorly motivated learners sabotage any lesson, no matter what his didactical strategy. He therefore begins every lesson with a motivational activity, which, he says, is a tactic he learned from his mentor teacher:

He would uh, before every lesson he would uh, give them a word or two about motivation and then I would uh, I saw that this...is...is...is it's encouragement for them and then the performance changes because of that. And then, uh, it also worked for me when I went back home because uh, I used these strategies and then it worked for me. And then I was able to achieve the learning outcomes. (SSI, 4:177)

When asked about being available to learners after class, Thabo expressed great willingness, but discussed this only in terms of further mathematical enlightenment:

There are learners that are uh, I would say that are inquisitive, especially after delivering the lesson, that they would want to know more about that, that would go an extra mile on their own. So when sometimes they would express difficulties, some of them, so if you are there for them uh, I think that would be even better. (SSI, 4:265)

Clearly, in Thabo's belief system interaction with learners outside of the classroom revolves around mathematics and not pastoral counselling. The roots of this belief lie in his own experience as high school learner, where the only assistance he and his friends required from a teacher outside the classroom was clarification of difficult sums:

We used to...we used to do that with my friends at school because uh, every time we'd practice... different problems and then those that we...we got problems would go to... the teachers uh, every mathematics teacher that we see in the school we'd go and ask about this and then it worked for us because even when we were writing the...the exam papers uh, we didn't experience much problems. (SSI, 4:269)

Thus, despite the fact that he knew the learners' names and they felt able to talk to him freely, "It was mainly about mathematics, it was mainly about mathematics" (SSI, 4:305).



#### 4.2.4.4 Summary

It seems that Thabo's vision of himself as a teacher of mathematics began when he was in Grade 9 as a learner in a disadvantaged rural school, teaching mathematics to his co-learners in the frequent absence of their teacher. His aptitude for and prowess in mathematics made him the obvious choice for this task. His love of teaching began at this point in his life. At university he expected to learn more only about mathematics but was amazed at how much there was to learn about the *teaching* of mathematics. His tertiary training therefore influenced his PMTI strongly on two levels: Subject specialisation and Teaching-and-learning specialisation. In particular, he learned about making mathematics come alive in the classroom through the use of manipulative and practical demonstrations. His experience on teaching practica influenced his PMTI in that he was able to learn from the experience by amalgamating what he saw in the classroom – the mentor teacher's classroom practice – with the theory he had learnt at university, to develop and improve his own classroom practice. He sees mathematics as Problem-solving in terms of Ernest's (1988) model. As shown in the figure below, these four influencers are almost equal in their effect on Thabo's PMTI.

Figure 8 emphasises the fact that Thabo appears to have a real love and appreciation for mathematics as a subject; in fact it seems almost as if he is in awe of its magnitude compared to his knowledge of it. It is this enjoyment that he wants to share with his learners: he wants them to see what he sees. In his perception of his own PMTI, Mathematics Specialist and Teaching-and-learning Specialist are ranked equally. He does not expect his learners to be compliant listeners and passive absorbers – he explains carefully while also facilitating understanding through learner participation. In terms of Ernest's categories, Thabo is recognisable as both an explainer and a facilitator. His desire is that the learners understand and are able to participate fully in the lesson. Therefore he explains as much as seems necessary and encourages the learners to ask questions and to express their understanding or lack thereof of the concepts he is teaching. However, his relationship in the classroom is with the subject first, and then with the learners, although he does not distance himself from them in any way.

In his enthusiasm and passion for the subject, Thabo tends to pitch some of his teaching above the heads of his learners without noticing that he is doing so. He does however look at the body language of the learners to gauge whether they understand or not; he also asks questions eliciting

individual participation – but he often answers the question himself without allowing the learners enough time to think. This he ascribes to the tight time schedule of the lessons. He believes in thorough and careful lesson preparation: this gives structure to the lesson, and helps in classroom management – the learners can see that you know what you are doing and where the lesson is headed. Thabo admits freely that he lacks the skills to counsel learners in a pastoral sense. He is however available for mathematical assistance at all times, even beyond school hours. He believes that his own learning process has just begun: he thought that, having taught mathematics while still at school that he had nothing further to learn about teaching – by his own admission he will not make that mistake again.

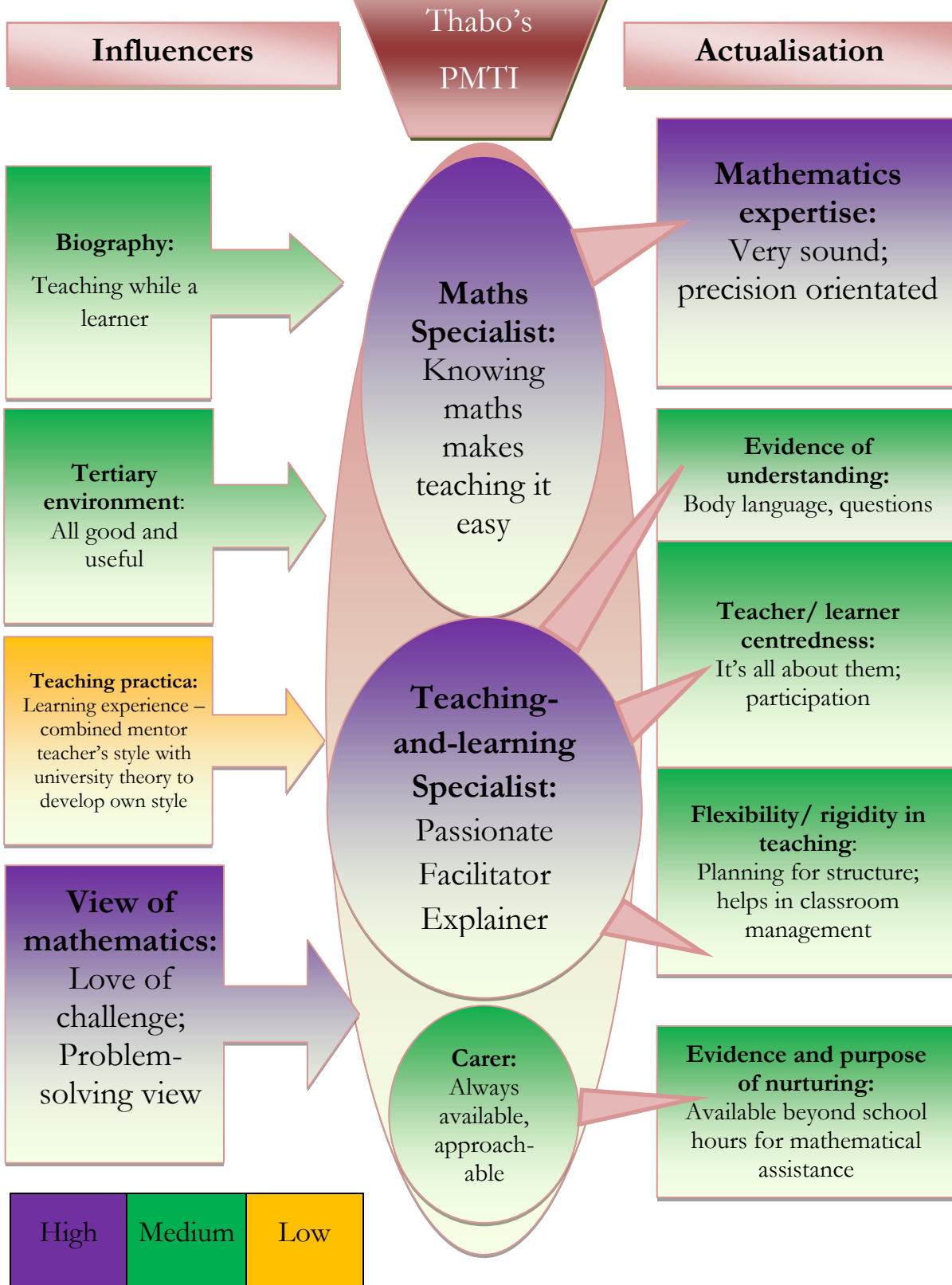


Figure 8. Thabo's PMTI according to the Conceptual Framework

## 4.2.5 John

John is a keen sportsman and likes being involved in team games. Educated at a private boys' school in Johannesburg, John achieved a D (50-59%) in mathematics at the end of Grade 12. He then enrolled to study engineering at a local university, but his enrolment forms were lost in the process, so he came to Pretoria, where it was too late to enrol for engineering. His only option, where enrolment was not yet closed, was in the Education Faculty at UP. Instead of changing back to an engineering course the next year, he elected to stay in teaching, where he achieved good results, with an average mark of 62% and a mathematics average of 60%.

### 4.2.5.1 Influencers

#### *Biographical factors*

John did not always want to be a teacher. He was a shy boy at high school, but he described his education as good and generally uneventful. His Grade 12 marks were good enough to allow him to contemplate a career in engineering:

Well, first of all I didn't choose to become a mathematics teacher. I was...I applied for engineering before and then they lost my forms and stuff at the University of Johannesburg so I came to Tuks and I was too late and then they said as long as I've been in university I can change. So I applied for, obviously, the teaching. And when I was in here I thought of taking Science and all that so I could change to engineering, but then I decided I was mostly into my sports so I did the sports management degree and I thought, I enjoyed mathematics at school so I might as well take it at university as well. (ISI, 4:12)

It would seem, therefore, that a career in teaching mathematics was not his initial aim or ambition, and that his choice of mathematics as a major subject was more serendipitous than driven. John's first love is sport, which is why he chose a BEd Sports Management. He explained his decision to complete the BEd degree without changing to engineering, as he originally intended on the grounds of his personality, which he described as follows:

Well, in high school I was a very...I was an introvert, basically, I did not...I hardly socialised with anyone, I didn't really have friends. Females were a bit of a distance from me and stuff like that. I went to an all boys' school as well, so from matric to now I've grown in confidence, I've grown in

my knowledge, I've pretty much applied myself to everything that I've done and I know now that whenever I start something I just have to finish it, I can't do it half way. (ISI, 4:64)

It may well be that his initial selection of engineering as a future career was prompted by two factors: his introverted nature, and his ability to do science and mathematics. Possibly the combination of these made engineering seem the obvious choice at the time. However, teaching, despite the fact that he says he has completed his teacher training because of his tenacity in finishing whatever he has begun, is something he finds thrilling: "From visualising yourself as sitting in that seat listening to a teacher and then feeling yourself in the teacher's position and giving that knowledge, there's an excitement about it!" (ISI, 4:68). The strongest influencing factors in his personal history he perceived as lying within his own personality. Friends and family appeared to have exerted little influence on him in this regard. Looking back now on his schooling, he acknowledges that he had good mathematics teachers whose example has helped him to be the teacher he currently is.

When asked whether he would choose to stay in the teaching profession, he confirmed the pleasure it gives him, but could not commit himself to teaching in the long term: "Stay in the teaching profession? It's tough to say at the moment. I'm enjoying it at the moment, but where I want to go with my life I'm not too sure..." (ISI, 4:96).

### ***Influence of the tertiary environment***

He seems quite satisfied with the training the BEd programme has afforded him; it helped him form an idea of what a mathematics teacher should be. Upon being asked whether his tertiary training has changed who he is as a teacher, John answered by describing the journey through which he had come as a student:

INTERVIEWER: Let me put it like this, let's say you went into teaching after matric, stood as a teacher in front of a class as opposed to standing in front of a class now- are you two different people?

JOHN: Yes, you wouldn't know what to do if you did it straight after matric. I suppose doing it now it's a lot more because you've come out of that whole school environment completely and you've joined another environment of learning and you've taken that knowledge back. So what you've done

is you've gone in a complete cycle before you even come back to your school which allows you to get rid of all the teenage years, I suppose, or insecurities and things like that, to engage more people. (ISI, 4:78)

John's tertiary training provided him with not only expertise and knowledge, but with the opportunity to mature, to "get rid of all the teenage years". John could not elaborate upon his expectations upon enrolment, but he did indicate that he had supposed the level of mathematics taught at first would be higher.

INTERVIEWER: Given that you tried for engineering first, eventually you enrolled to teach. What were your expectations of the training to become a mathematics teacher? What did you expect of the modules, in the beginning now?

JOHN: Of the modules? In first year and second year I was a bit surprised that all we did was mathematics from matric, I thought being in university and all we'd go a step further and stuff like that and eventually it started coming on that we started developing this teaching style and how you'd implement your teaching style in the class. So I thought the modules are great but I think more practical examples need to be implemented within the works... (ISI, 4:46)

He explained that theory was all very well, but that actual real-life applications of the theory to demonstrate teaching strategies would be more effective:

So, in other words, while learning about the subject and learning the newer mathematics and keeping up with the knowledge; bring people into the class and say, "How would you teach it? Come in front here and present this lesson in the way that you've learnt it right now". Just to give them a feel of how it feels standing in front of people, sharing the knowledge and just also trying new things as well, as opposed to just sitting back in your seats and saying, yes I've got it all the time. (ISI, 4:52)

John's tertiary training was particularly effective in accelerating his maturing process: an understanding developed of what it meant to have changed roles from learner to educator which he described as "... visualising yourself as sitting in that seat listening to a teacher and then feeling yourself in the teacher's position" (ISI, 4:68).

### ***Influence of teaching practica***

John admitted during his initial interview that, as a young, inexperienced student, going on teaching practicum filled him with trepidation. These fears were soon allayed when he actually began to teach:

...doing a prac is daunting and like two weeks before it's like, what must I do, shaking, nervous and then once you get in the class and you start engaging with the kids you see how easy it becomes because, I suppose, you were at that level not so long ago... (ISI, 4:72)

John did not experience any conflict between his theoretical training and his practicum experiences; he found that teaching practicum enhanced his own practice – not only could he learn firsthand from his mentor teacher, but he had the opportunity to air and develop his own teaching style.

In her responses in the Mentor Teacher questionnaire, John's mentor teacher expressed her pleasure at seeing how well he used the practicum period to connect to the learners and establish a rapport with them. She claimed that he really made the effort to meet them at their level of knowledge so as to make their understanding and acceptance of new work easier: "By the nature of the visit, John had to focus on the process. He looked at *what* his class knew and concentrated on *how* to lead them into new work."

It would seem fair to conclude therefore that John's understanding of what it means to be a mathematics teacher was modified through the practica, not so much by an increased awareness of the necessity of deepening his subject knowledge, but by an increased awareness of the usefulness of teaching skills and the benefits of being able to build relationships with the learners. He also found that the belief with which he began his teacher training was confirmed in the practica: that relationships are easily established on the sports field and that those relationships make teaching in the mathematics classroom easier.

### ***Influence of his view of mathematics***

John sees mathematics as the connectivity between aspects of the real world – it "just brings everything together." Mathematics "helps create equations for us to link things to each other" and it gives values to things "we would not normally value". It would therefore seem that he believes that mathematics is inextricably linked to the real world and that it should not be divorced in any abstract

way from the reality in which we live, since it “creates a different set of terms and situations that we use in our daily lives” (SSI, 2:7).

His understanding of the purpose of mathematics as a subject is influenced by this viewpoint: he believes that, if at all possible, all topics need to be linked to the real world so that learners can understand the usefulness of the knowledge and techniques they are acquiring through study of the subject. This linking is not always easy – for some topics, he says, “I’m still struggling to see the connection, but there is some sort of connection – you just need to always find it” (SSI, 2:9). However, his reasoning goes even deeper: even if the purpose of a topic in mathematics is not obviously discernible, “it always has a purpose no matter what you do, just how it influences your life is, well, that purpose...” (SSI, 2:9). John’s personal experience of the subject undergirds this belief. He explains as follows:

JOHN: I think one day I just woke up and thought, you know, it’s time to take life a bit more seriously and stop messing about and get on with my life. So...

INTERVIEWER: And mathematics was part of that?

JOHN: Ja, mathematics just happened to be the “go for it”. (SSI, 2:21)

The subject itself therefore appears linked in his belief system to “taking life seriously” and becoming a mature, responsible person. The very nature of the subject thus influenced the direction of his life and thinking. It would seem that John’s viewpoint is best described in Ernest’s (1988) model as Problem-solving: “a process of enquiry and coming to know”. He sees mathematics as something to be explored, particularly as it relates to the real world.

John’s appreciation for mathematics and the value and purpose which he sees in it did not originate during his own schooling. He explains that his passion for the subject developed at university to the extent that, in terms of what he should choose to teach, “that is what drove me to mathematics.” In fact, he says that he could have chosen to teach Life Orientation during his teaching practicum, but that seemed to him to be a waste of time. Instead, “I chose to go the more difficult route and teach mathematics” (SSI, 2:17).



#### 4.2.5.2. John's PMTI

When John was asked in the initial interview how he would describe a good mathematics teacher, his description touched on two of the aspects of PMTI that this study examines: Mathematics Specialist and Teaching-and-learning Specialist: “A good mathematics teacher? Someone with a passion for mathematics, someone who is beyond what they would normally learn for mathematics [Mathematics Specialist], and someone who also interacts [Teaching-and-learning Specialist] more than just content based so, ja” (ISI, 4:8). From this statement it can be deduced that John believes that knowing the subject, even knowing more than is required, is as important as knowing how to interact with the learners in a way that is not just subject related.

The question of who he is as educator elicited the following answer:

Ok, myself as a mathematics teacher. Well, obviously you need to know your content to know where you're going with your content, but just as equally I need to know how much I can push myself and how much I can interact with other kids and things like that. Being a pastoral role is for me the main thing. (ISI, 4:20)

John does not believe that he knows it all, to which his mentor teacher testified: “... and also what's been very impressive is that he hasn't come here pretending to know it all. He's come with questions and used that intuition well to supplement with what he's already had” (Mentor Teacher interview, 1:20)

#### ***John as Mathematics Specialist***

John gave being a subject specialist top priority in his PMTI. “The subject needs most attention because it carries the bulk of the knowledge and skills within a certain context of the learners and teachers” (Q, 2:200) Therefore, it would seem that to John, despite the fact that he says, “being the pastoral role is the main thing” (ISI, 4:20), being a Mathematics Specialist supersedes this because he believes that the subject matter is the vehicle for the other roles: “The subject specialist in my opinion has the most because at the end of the day the knowledge and skills should pertain to the overall likelihood of a person” (Q, 2:196)

### *John as Teaching-and-learning specialist*

In the ranking exercise, John declared that being a Teaching-and-learning Specialist is equal with being a Carer in his PMTI. He explained his reason as follows: “Without the proper implementation or preparation the necessary knowledge and skills will not be understood in the context in which they should be, and thus be linked to abstract knowledge or skill” (Q, 2:203). This statement may be interpreted to mean that John believes that it is the teaching skills and strategies of the adept teacher that take mathematics from the realm of the abstract to the realm of the real and understandable world. To him, creativity is an essential requirement for teaching the subject successfully and is not limited in terms of topic or grade to which the topic is being presented.

Let me explain it to you this way, “Take out your text books, turn to page this. Do this exercise”. It sounds so boring, whereas if you’ve got something on the screen, now you say “Visualise this; explain to me how this happens. Look at this picture, what- if you rotate it this much, what happened to the picture, look how the dimensions change”. There already you’ve just created a whole new perspective of mathematics and a whole new situation that...that can be derived from creativity. So, creativity is essential, for me, in mathematics, not necessarily easy but it needs to try and work its way in... (SSI, 2:37)

The difficulties, according to John, are twofold: creativity takes time, and new ideas are hard to come by: “I mean, within my four years I’ve had probably five great ideas that I’m going to now take into my...my teaching but four years to have five ideas is, if you look at it, not a lot” (SSI, 2:37). He believes that using technology is a boon to the mathematics teacher, and helps to make the mathematics classroom a place of interest which, if the textbook were the only tool, it would not be:

JOHN: Once I tried something different, I tried the textbook approach and I saw that didn’t work. So I went back to the drawing board and said let me create a PowerPoint on it, let me create this on it, let me even use GeoGebra to help them better understand and that...that seemed to have worked.

INTERVIEWER: Do you have GeoGebra on your laptop?

JOHN: Yes I do.

INTERVIEWER: Do you find it useful?

JOHN: Very, very. All teaching tools are made from God; they’re just there to make your life easier so why not use them? (SSI, 2:277)

In close association with his belief that mathematics is consistently linkable to the real world lies his belief that “There always has to be scope for creativity” (SSI, 2:33). In his belief system, divorcing mathematics from the real world would mean losing the power to make each lesson an exercise in creativity and would make dependence on the textbook alone inevitable.

### ***John as Carer***

John places a high value on relationships in order to promote the interaction he requires in a lesson. His personal experience has taught him that good relationships promote good communication:

For me, if I don't have a good relationship with someone that communication falls through the roof.... It's happened to me in my life, it's happened to me in my family, it...it just doesn't work without a good relationship... So what I try to do is bring...get onto the learners' level, ...get onto how they react to each other ... (SSI, 2:205)

In addition to finding teaching exciting, he reveals an intrinsic propensity, derived from his own learning experience, for dealing with learners in such a way as to facilitate learning. John declares that the pastoral role of the educator is of paramount importance to him. His intuitive understanding of the difficulties of 'learner-hood', based upon his vision of himself as a learner, is revealed in the reasoning behind this statement:

Being a pastoral role is for me the main thing. The reason why I took mathematics and sports so close together is because I believe thoroughly and that from the sports field to a classroom is a big gap, but that gap is filled with relationships and based on those relationships the learning inside the classroom improves a lot. So with that, knowing my subject, knowing the kids, knowing what I can do for them, that makes life so much more easier. (ISI, 4:20)

John is an avid sportsman, who believes that the relationships cultivated on the sports field make a positive difference to the classroom dynamic. This intuitive understanding guided his decision in studying Sports Management with mathematics as a major subject.

### **4.2.5.3 Actualisation of John's PMTI**

Asked what strikes him most strongly when he sees himself teaching on the video, John refers to the fact that he frequently turns his back on the class to write on the board.

'Cos you break your eye contact for a minute and that's where the trouble starts. That's where they think your back is on them so now they can get away with things ... or it just gives them the opportunity to do something that they shouldn't be doing. So, in that sense, you need to always have eye contact with them and in that way you can always see whether they're lost there or not. (SSI, 2:193)

His own teaching style he describes as interactive, with an emphasis on humour.

### ***Mathematical expertise***

It would seem then that although John believes in the importance of being a Mathematics Specialist, he has not yet been able to make that a strong point in his own classroom practice. While John has honed his didactical skills, possibly at the cost of spending the time necessary to improve his mathematical knowledge, he is very much aware of the difference between knowing the subject and knowing how to teach it: "because me understanding the work and giving my knowledge to someone else is two very different things" (ISI, 4:60).

John's admission of not preparing his lessons as thoroughly as he could in terms of the content may be the reason, apart from his lack of experience, behind the shortcoming his mentor teacher was referring to when she said upon being asked where she thought he could improve,

Perhaps in a bit of the background knowledge. It's very much textbook based at the moment but that will come with experience and it will come with more reading, again, that's experience as he teaches. He is able to think on his feet very well, there've been a few times when questions have caught him out and he's coped so well with that and he's gone back to the basics but there are a few basics where he can still read up and improve. Not specifically algebra, not specifically geometry; he has a good over-all knowledge of what's being needed for the FET phase but I think it's mostly experience, that will come. (Mentor Teacher interview, 1:12)

In analysing the videoed classroom observation, it is however clear that John is extremely comfortable with the topic he is teaching. He was able to answer every question without hesitation or consultation with his file.

## ***Teaching and Learning***

John is willing to spend much time and thought on making each lesson “work” not only in terms of the learning outcomes, but also in stimulating the interest of the learners. For example, the idea of creating a “knowledge box” on a part of the blackboard into which facts that are discussed and mutually accepted are placed came to him while attending a staff workshop. From the head of the mathematics department at the school he was teaching in he learnt about the usefulness of “teaching Pythagoras using squares to explain how a triangle works” (ISI, 2:53). From a lecturer at university he learnt about the potential of PowerPoint and the Internet in making the topic come alive for the learners: “I take my own laptop, search the Internet for PowerPoints, find something I like and adapt it to what I think is necessary...” (ISI, 2:61). It seems clear then that John believes that teaching mathematics requires continual effort in order to relieve the drudgery of the classroom.

In the observed lessons he used real-world examples to elucidate the concepts he was explaining. While some such explanations were obviously pre-planned, like his slides of various logos and commercial symbols to illustrate symmetry and different types of transformation, others were spur-of-the-moment, used when clarification was required, like his quizzing of the learners about their knowledge of pizzas to clarify his answer to a question regarding fractions.

His personal goal in the classroom is to hear the learners say, “I get it!”

You’re explaining a topic, everybody’s looking at each other and then one boy says “I get it!” and then he explains it and then it’s like a...a rolling ball, it just...it knocks on to every single one in the class. ‘Cause for me that’s just...that’s just the way life should be. “I get it, let’s do it!” So, as a mathematics teacher, ja, that’s pretty much what it’s about. (SSI, 2:229)

## **Evidence of understanding**

In the observed lessons he is observed using a different questioning technique – instead of asking individuals he also poses questions to the entire class, eliciting a group response. Asked why he believed this was effective, he explained:

I suppose it’s to see where everybody is. If ... I choose a person every time then I only know where *he* is, whereas if the general class gives me an answer or gives me an incorrect answer, I can explain

to them ...where they're going wrong, where aren't they going wrong. Whereas with this specific person, he could come up with one issue that another boy doesn't have the [problem] with .... So in ...general you've got to have the whole class active in the role. (SSI, 4:125)

In addition to this, John believes that observation of the learners' behaviour is a good indicator of whether they understand or not. The rapport he has with them, combined with the ability to envision himself as young learner, enables him to interpret body language in the classroom in what he feels is an efficient and effective way. His strategy in this regard is to keep alert for a change in the learners' expressions, which in turn would cue him to explain again or use different words or examples to elucidate.

Basically, I always link my knowledge back to how I would feel as a child sitting in there, listening to this teacher. I constantly look around the class and see how the boys' expressions are because I gather exact expressions. So as soon as I get those expressions of blankness or don't-know-what - I'm-doing I engage that child immediately and the mindset of the child and of myself just changes completely. (ISI, 4:68)

In the observed lessons it was noticeable that John not only paid attention to the reactions of the learners, but that he encouraged them to communicate freely with him throughout the lesson. His method of teaching largely entailed posing leading questions, guiding the learners to a discovery of the knowledge about which the lesson revolved. At no time was he seen to be "lecturing" the class. It would seem that meaning in any new topic is negotiated by the learners so that it becomes their own. This is a strategy that he believes works:

You can just see by the way they sit, they react, they work. If they...if they sit in the corner messing around then you know that that's going to now shift over around the classroom, people are going to start laughing, losing their focus and things like that. Whereas if everybody's looking at you, when one person asks, they look at the person or ... they're still looking at you with a blank expression. At least you know they're engaging, they don't understand, but they're still there. Why don't they understand? You see ...you've got to pick up, ...you can't only teach them, you've got to pick up why or how they're learning, pretty much. (SSI, 4:133)

While John believes that homework sounds "horrible... and old-school", it also serves as evidence of understanding.

## Teacher/ Learner-centeredness

He is committed to learner-centeredness in his teaching:

Not interacting with someone is...is...is one person talking at a time, is one person teaching a class of quiet kids. To me, interaction breaks that silence, it brings everybody to the party and then at a party you always have fun, so, mathematics makes fun- that's where the humour comes in. (SSI, 2:201)

Not only must his lessons be stimulating, but each one must begin on the right note, lest the atmosphere be lost. The mentor teacher with whom he was placed believed in starting each lesson with a joke, a riddle or a puzzle. John decided to adopt this into his own repertoire of strategies because "to *get* the kids in the class" is "the first mission". So, once the practice has been established that each lesson begins in this way, "as the kids come in the class they go straight to the board and they're looking and trying to figure things out" (SSI, 2:69). As part of his strategy not only to *get* the learners but also to *keep* them, he believes that it is important to access their prior knowledge: "To me it's...it's a building block, if I'm going to build a little thing out of Lego I don't start from the top and build my way down, cause that's impossible. So I start from the bottom and build my way up... And that...that, to me ...every block that you can build up, moves...the learner into understanding why..." (SSI, 2:85).

Once the lesson is underway John favours the Socratic style of teaching by asking. He finds that this provides him with an insight into the level of understanding of his learners at any given point:

So by asking them ...you find out what they, at the moment, think it is, 'cause if I tell them a statement they can either believe it or not, or go with their own way still, or mix it, which is the worst thing you can do because then that completely throws them off, and I find by halfway through my lesson I've got boys ... asking me "What is this? What is that?" So I ask them, see where they are and then I evaluate on that to go further into detail. (SSI, 2:93)

This particular technique he says really became embedded in his teaching identity at university where

They'd tell you what something is but then they ask you why is it like that. The...the question why always creeps its head in somewhere. So at school you had teachers that said "this is like this and this and this", now at varsity you have lectures that say "why is it like this and this and this". So it just puts you on another level of thinking. (SSI, 2:113)

In his own teaching experience he found that explaining to learners the “why’s” behind the reasoning helped them to a deeper understanding of the concepts he was teaching. It also motivates them to engage with the subject:

If they understand why they’re doing it, how it’s going to affect them in the future, then they’re either going to grow a passion for it or they’re going to at least try to do something so that they can use it. (SSI, 2:217)

John’s teaching philosophy is particularly well illustrated in a situation during a particular lesson where a learner makes a mistake in an oral response. John does not correct the learner, but instead asks him twice whether he is sure that his reasoning is correct. Asked why this strategy works for him, John explains:

Because if...if I told him he was wrong he’s going to look at me and say, “Well, why am I wrong?” and I’m going to have to tell him why he’s wrong. Whereas if I ask the question, “Are you sure?” he thinks to himself “Am I right or am I wrong?” So then he goes through the whole process again checking and rechecking ... so in the end he figures it out for himself in his own head and then he comes with, “Oh yes! Ok, I know why...where I went wrong, why I went wrong”. (SSI, 2:145)

This, he believes, instils in the learner the habit of reflection, “So, if they...they are able to do it at that level, they can take that straight through their entire life” (SSI, 2:153).

John also believes that new concepts should be introduced on the basis of what the learners already understand. In one of the observed lessons he spent nearly a quarter of the lesson time drawing information from the learners about fractions, thus making sure that all were on the same level of understanding before he began to deal with new knowledge. His teacher confirmed that this was not just a technique used for the benefit of the camera:

He has a very natural way about him; he has coped with mathematical questions really well; he’s understood what the children’s pre-knowledge has been and he’s realised what they need in order to cope with the new work. So yes, he’s got the makings of a very good mathematics teacher.



## **Flexibility**

An interactive teaching style implies that a lesson does not necessarily proceed according to plan. However, John believes that planning a lesson provides a general structure to which the lesson can return after distractions. It is important to be adaptable, he explains.

So, if you've planned a lesson, you know exactly where you're going with the lesson, you know what you're supposed to achieve with the lesson but then again, as much planning as you can do will never prepare you for the questions that boys ask or anybody, a learner asked. So, you've always got to expect the unexpected but you've got to have that plan in place to go forward with your lesson. (SSI, 2:241)

The only thing that he can be sure of, he says, given the way he teaches, is the atmosphere he establishes in the classroom.

## **Evidence and purpose of caring**

The most prominent of John's beliefs, both in what he says and what he does, is his conviction that the existence of good personal relationships with the learners makes teaching easier. He believes that sport is a means of building such relationships, the benefit of which is then carried into the classroom. In his initial interview John described his belief that the knowledge about a learner acquired outside of the classroom context was valuable inside the classroom:

Because mathematics...everybody doesn't like learning, well, most people don't like learning and for a kid that struggles to learn, for instance, they're a good sports player or they enjoy being in the sports field, their whole personality opens up to you. So you have a different view of them and you can focus on their strengths and bring it into the classroom. (ISI, 4:24)

His strategy was to get to know the learners by name because that created an immediate rapport:

I basically got to know the kids by name first in the classroom and that lead to me getting involved as quickly as I could with sports, and through my sports I got to know more kids that were in my class that I wouldn't have got to know otherwise. If you would look at it from the point of view as engaging a class of forty kids at a time. So getting to know all of them by name was a very important part of it. (ISI, 4:32)

He recounted an incident where a boy in his class taught him a particular handshake – “and of course I'm going to do that 'cause now he can relate to me and I can relate to him and that puts it on a

completely different level” (SSI, 2:209). The fact that he makes an effort to reach his learners by involving himself on their level in a personal way makes the class more “comfortable”:

It makes the boys more comfortable to ask questions in class, in other words, I’m not just this figure that just stands up there, and if you put up your hand you’re shaking already just to ask the question. So it just makes life, in general, more comfortable around. (SSI, 2:209)

This would seem to confirm the notion that John’s classroom practice, in terms of the skills and strategies he employs to optimise the learning opportunity, is based on care and concern he has for his learners. John recounted an anecdote in support of this belief:

JOHN: People respond more to their names and their personal being than anything “Hey you, boy”, “Hey kid” or “Yes Sir” or something like that. So, like for instance, my second year prac, as soon as I got one of the boys’ names he immediately opened up to me and then we started a whole learning thing going back and forth on the sports field. It’s a very dangerous place to be as well as keeping the professional boundary, but it’s a necessary place that you should be at.

INTERVIEWER: So, would you say it’s easy to become too familiar?

JOHN: Yes, it’s very easy.

INTERVIEWER: Particularly because you’re young?

JOHN: Ja, especially because we’re young because the kids feel “Oh, he’s not that much older than me, why can’t I...?” but you’ve just got to keep that respect the whole time. (ISI, 4:36)

John is therefore aware of the pitfalls of building a relationship with the learners – the line between what is professionally acceptable and what is familiarity can become blurred. However, the benefits of this strategy outweigh the risks. He refers to this as the “pastoral role” which he calls “the main thing”. His ease in his comportment with the learners communicates itself positively even to the most recalcitrant of learners. His mentor teacher was particularly aware of this:

I have loved his relaxed manner with the students. It has appealed especially to the boys. He’s used a very gentle humour even though many of our boys are not gentle and he’s been able to connect with certain key figures in the class so that he’s got them on his side and that’s been a very good.

The result of this mutual respect, as evidenced in the video footage, is an atmosphere conducive to positive attitudes and effective learning. In order to keep this atmosphere intact, John does not respond negatively when a learner provides an incorrect answer. Instead he redirects the learner to

the thought process by asking such questions as, “Are you sure that’s the answer?” or “How did you get to that answer?” His mentor teacher described him as being intuitive and sensitive to the nuances within the classroom. When asked whether he thought it is a good idea to be available to the learners outside of class, John explained that being an interactive type of educator means that “I’m there for their whole experience of school.” That, he said, means that “I’m there for teaching, I’m there to help them with life as well” (SSI, 2:297).

#### 4.2.5.4 Summary

John did not intend to become a teacher upon leaving school. His enrolment into the BEd course was accidental, an option open to him when engineering was not. Nevertheless, he elected not to change back to engineering after his first year because he found he was enjoying what he was doing. He is aware, retrospectively, of the influence his mathematics teachers have had on him: they taught well and were good role models. He describes his tertiary training as a maturing process in which he could see that he had changed positions from being on the learner side of the desks to the teacher’s side. He described this process as coming full circle. He would have liked the training to include more practical applications of education theory, so that, before entering a classroom, one could experience what it feels like to stand in front of people. The reason for this suggestion soon becomes clear: going on teaching practice filled him with fear. Only when he actually began to teach did the fear dissipate, as he realised he could identify with the learners, having been one not so long ago. He also found that relationships made on the sports field made teaching easier and that the teaching skills he had been taught at university were useful. John sees mathematics as inextricably linked to the real world and that, even when he is unable to see that link in certain topic, mathematics influences one’s thinking bringing about maturation. His view of mathematics is what Ernest (1988) describes as Problem-solving, since he sees the subject as something to be explored and it links to the real world discovered and examined.

Figure 9 shows how John’s PMTI may be presented visually. Despite the fact that John ranks Mathematics Specialist as first in his PMTI, almost every statement John makes reveals the value he attaches to relationship as a springboard for effective teaching. He uses humour to engage all the learners. The equality which he recognises between the aspects of Teaching-and-learning and Caring in his PMTI is confirmed by his mentor teacher. She believes that he has the necessary teaching-and-

learning skills to compensate for his inexperience with the mathematical content of the high school classroom. In the classroom, John demonstrates his ability to use his understanding of the *learners* to improve *their* understanding of mathematics. He believes in being creative and innovative in order to take the boredom out of mathematics lessons and to make them relevant to the learner's lived worlds. He seems to be a facilitator, in terms of Ernest's categories. At all times during his lessons, he has the learners 'eating out of his hand' – their participation is keen and enthusiastic, yet discipline is not a problem. The impartation of content knowledge during the lesson is done almost imperceptibly, as the learners are guided into constructing it for themselves. When they do not understand, he is able to tell from their expressions and behaviour that he has lost them. He poses both individual and chorus-answer questions, believing that his relationship with the class is open enough for them to be honest with him. He describes his style as interactive and spiced with humour. He believes that starting a lesson with a riddle or puzzle of some sort (something his mentor teacher did) works, as it sets the right atmosphere for the rest of the class. He also believes that teaching rules without reasons is futile, and that explanations he gives need to answer the question, "why?" When a learner answered incorrectly, he guided the learner into reflecting on his own answer and correcting it, instead of just supplying the correct answer – all because his aim is to cultivate in his learners the habit of thinking for themselves. He believe in lesson planning, but only because it allows him to be flexible. He says it is impossible to plan a rigid structure for a lesson, because the dynamism of the class may change things.

The most prominent aspect of John's PMTI is that of Carer. His classroom practices are based on relationship with his learners and the concern he has for them to do the very best they can under his aegis. Having been an introvert himself at school, he makes a point of getting to know the learners' names and drawing them out of their shells within the safety of his classroom. His intention is the establishment of mutual respect between himself and the learners, but he is aware of the dangers of over-familiarity. His care for is learners goes beyond the exigencies of the classroom and the subject itself – he believes he is there to help the learners with life in general as well.

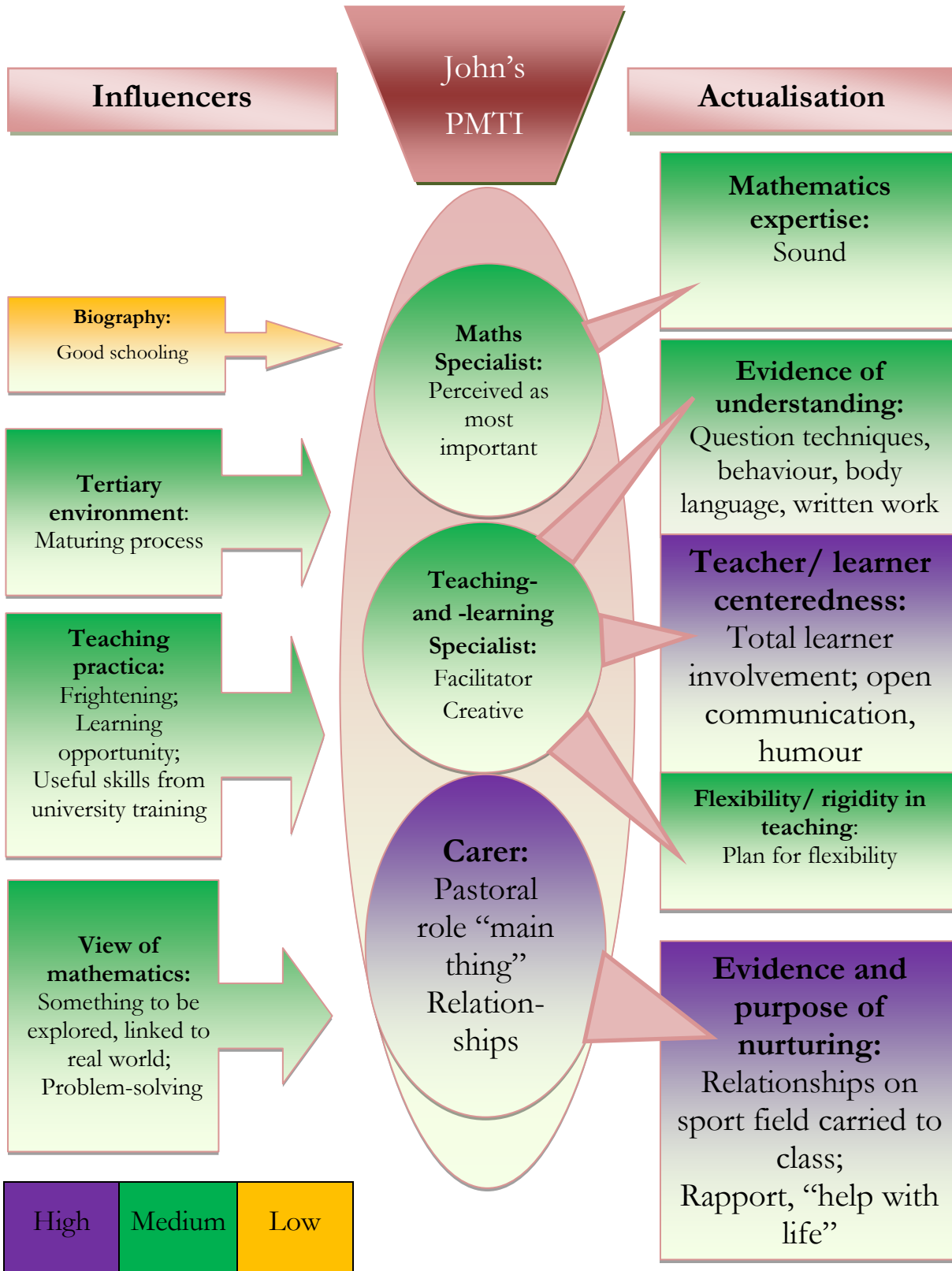


Figure 9. John's PMTI according to the Conceptual Framework

## 4.2.6 Sipho

This student received his high school education in a school which fitted into the erstwhile ‘Model C’ category in a large town situated in an otherwise rural area. As a young black learner he experienced the mathematics classroom as a place where he had to prove himself. He achieved an E (40-49%) at the end of Grade 12. At university he worked consistently and well, achieving an overall mark of 61%, with an average of 62,5% for mathematics.

### 4.2.6.1 Influencers

#### *Biographical factors*

The nature of the influence of his high school experiences was revealed in the interview. He was taught at a school which fitted into the erstwhile ‘Model C’ category in a large town situated in an otherwise rural area. Here his teacher appeared to be prejudiced against the non-white learners:

Where I was taught, the school I went to was...we had white people and black people and we had a white mathematics teacher. Now, the treatment towards us, towards all of the black learners in the classroom was very bad and she was racist, you know, and every time she would demoralise us. She would make comments, like really seriously bad comments... Like “You wouldn’t pass”, “You won’t make it”, “This subject is not for you”, “Consider choosing another subject” and at that time there was no [subject called mathematical] literacy so you had to change [to standard grade]. I experienced in the classroom where we were mostly half-half, half black, half white - the Indians and the coloureds fell into the black category. Most of them dropped out, left mathematics, moved from higher grade to standard grade... Things like that, to me, were an eye opener so I just decided that I wanted to make a change, make a difference and to prove that particular teacher wrong that we can, and we will. (ISI, 4:24)

It would seem, therefore, that this student was driven by a need not only to prove himself, but to help others prove themselves as capable students and educators of mathematics, flying in the face of racial prejudice. He felt then already that he could do better: he could not only become a teacher of mathematics, contrary to his teacher’s pronouncements, but he could show that it is possible to treat everyone in a classroom with equal respect. His family’s ideas and his own psychological disposition regarding becoming a teacher of mathematics did not enter into his discussion about who he is as a

mathematics teacher at all. Instead, he emphasised the importance of understanding the psychology behind teaching and how to handle “the mentality that goes with mathematics. In order for you to teach it you have to understand it, you have to understand the whole idea, the feeling people have with this subject...” (ISI, 5:8). He believes that mathematics has an emotion component which needs to be addressed – learners can be helped to enjoy the subject if the teacher makes it a priority to do so.

### ***Influence of the tertiary environment***

Sipho entered university directly upon leaving school, determined to learn to teach mathematics. He found, however, that the programme did not quite live up to his expectations, although generally speaking, he believes it was worthwhile. Sipho believes without a doubt that upon completing his training he will be adequately prepared to teach mathematics, and that he has become a reflective practitioner. He also declared unequivocally that his image of a good mathematics teacher has changed during the course of his training.

In his initial interview Sipho indicated that the greatest positive influence of his tertiary training on his identity as a teacher lay in a psychology module, in which the students were taught about the way learners think and learn:

Ma’am, it has to do with the psychology. I am very lucky that I came to TUKS [University of Pretoria] and here they presented a psychology module throughout the whole three years and that helped me a lot in understanding the other person, learner- the person that’s in front of you. Well, obviously I will be a teacher so I see things differently now, I’ll view everything differently as I will be standing in front and looking at the learners, looking into their eyes. (ISI, 5:32)

Sipho described his uncertainty and insecurity as a new young student, unsure of himself and even more unsure of the academic pursuits that lay before him. He was surprised to find that the teacher training course was full and busy:

INTERVIEWER: Alright, now, I want you to think back over the last three and a quarter years. When you enrolled for your studies here at UP, what were your expectations of the training to become a mathematics teacher?

SIPHO: Yoh! Ma'am!

INTERVIEWER: What did you think?

SIPHO: I really didn't expect it to be this intense...

INTERVIEWER: What did you think that we would do with you here?

SIPHO: Oh, let me think. Well when I came here, when I enrolled, Ma'am, for me I still had that mentality that I want to help out, you know, and I was in shock because I was still a bit unsure about myself then on how I was actually going to implement that, how am I going to cope. So I didn't know what to expect, Ma'am. Anything that came, I was ready for it; whether we would do more practicals or more theory, I was ready for that. Honestly, I was ready. (ISI, 5:66)

Clearly, despite his inexperience and uncertainties, he was prepared to do what was necessary to achieve the success required to become a teacher and "to help out". It seems then, that Siphon had few preconceived ideas regarding his tertiary training. He was even unable to arrive at a coherent understanding of the "direction" the course was taking: "I just didn't know in which direction [we were going] until my second year where I went like 'Aha!', so that's where we're going to" (ISI, 5:79). As a First year student he threw himself wholeheartedly into university life, but it was only during his second year that he began to understand how the course was shaping him.

He found himself changing. The first changes he mentioned in the initial interview concerned the subject of mathematics and how it may be taught.

INTERVIEWER: Alright, now, let me ask you this: what changes do you perceive in yourself as a result of the training that you've done here?

SIPHO: Well, firstly I understand the subject better and the skill in presenting the subject- that has changed course. We're all individuals and we're very unique so now I used my experience, the experience that I had and how I was treated at school, I used that and I put that aside and I put what I learnt here on the other side and then I learnt and put another category from the other students, my peers, how they would do this. (ISI, 5:82)

Siphon realised the need to compartmentalise his experiences and beliefs. He identified three areas as his sources of beliefs and development: his experiences and convictions carried over from his own schooling; what he was learning at university in terms of subject knowledge and methodology, as well



as the “psychology” he referred to earlier; and then what he was learning from his peers and their ideas of how the subject should be taught. Eventually he was able to integrate knowledge and beliefs from these three areas into what he describes as his own style, who he is in the classroom:

SIPHO: From that I formulated just one thing...

INTERVIEWER: Your style?

SIPHO: My style, developed my style and I feel it’s effective. I don’t know yet. (ISI, 5:84)

Although Siphon was generally satisfied with the modules, he felt that more practical experiences should be included. He explained that he was really impacted by the methodologies and the technology employed by a lecturer to make the work more visual and comprehensible:

...Especially with the visual presentations ... just gave it that extra kick. It changed us, it changed the way you would view things. Right now you’d see a shape and you’d try and view it on a 3-D and imagine it, so it has changed, ja. That is very good. (ISI, 5:96)

Thus it may be concluded that Siphon truly did find that his tertiary training brought about change within his understanding, not only of the subject itself, but also of himself as a teacher.

### ***The influence of teaching practica***

Siphon found the teaching practica difficult because of the limited time given to accomplish the task, as he saw it, of establishing a relationship with the learners and then teaching them topics within the subject in a way that not only made the subject accessible, but that had an effect on the way the learners felt about the subject:

With the time limit that we had, three weeks. The first week you would just bond, you’d simply just talk to the learners individually and find out what they think and most of the time they’re interested, they’re curious- they’re curious to find out about you. Use that as a starting point, use that, the more they ask the more you push them to understanding where they are with mathematics, what they think, what they feel about the subject and then from there you can change that perception and that mentality right there by choosing exactly the right words. (ISI, 5:36)

However, Siphon ultimately felt very positive about his teaching practica. He found his mentor teacher to be a source of knowledge; he could put into operation his own teaching style, which was nevertheless influenced by the school environment, and he was able to make up for a lack of

experience with thorough preparation. He did however find that there was a difference between what he was taught at university and what he experienced first-hand at school. He was not quite prepared for the dynamic of the classroom, since nothing at university resembled the classroom, and no theory can explain how it “actually is”.

Above all, he would never teach the way he was taught as a learner. His teacher at the high school he attended as a learner he believed to be racist in that she frequently pronounced derogatory or demoralising statements over the black learners in her class. She did not believe in their potential, and was not reticent in saying so. He determined at that time to be different in his own classroom, and remained true to that conviction. All the same, issues of race remained part of his teaching experience while on practicum:

Well, I've experienced this thing at [a high school], Ma'am when we were teaching mathematics. Those learners, they are white learners, most of them. You know, just because you're a black teacher and I'm still young they didn't really take me seriously so I had to go the extra mile to prove it to them that I can teach this and I have the skill to help you to understand. Well, I've developed that skill through the years. (ISI, 5:112)

Therefore, although teaching practicum was a positive experience for Siphso, it was not without difficulties. The race issues which had shadowed his learner-hood were not absent from his own classroom as student teacher. The beliefs resulting from the time he was a learner in this regard dictated the way of handling these issues: by going “the extra mile” to prove that his knowledge and skill as a teacher were more important than the colour of his skin.

### ***Influence of his view of mathematics***

When Siphso was asked to explain his view of mathematics, he was unable to present a direct answer. Instead he said, “It's the logic behind reasoning” (SSI, 3:55). He was asked to expand on this statement, and did so by connecting mathematics to representations of a physical reality:

If you can explain something in terms of science, if you can explain something you should be able to can compute it into an equation, so that's mathematics. That's how I view mathematics, um, putting numbers to what you...to what you're explaining, putting some representative on paper, calculation, something that is logic, trying to explain the logic, you know. (SSI, 3:9)

He was convinced of the importance of the subject and harked back to his view of the subject. His reasoning followed an if-then pattern: everything in reality we must be able to explain, and if you can explain it, then you should be able to compute it in some way. Its importance as a school subject follows directly: you cannot live outside of reality, therefore you must be able to explain that reality. He does not see mathematics as a finite system, instead, he described it as “an art of science”. This statement led him back to his earlier reasoning, that if a thing could be explained, it can be represented in numbers. Siphó’s responses here may be described as recondite, but about one thing he was very clear: he enjoys mathematics.

#### **4.2.6.2 Siphó’s PMTI**

In his initial interview, Siphó described his idea of a good mathematics teacher in terms which touched on all three of the categories: someone who knows the subject, who is an expert in didactical strategies to make the subject accessible, and someone who is concerned with the feelings of the learners:

A good mathematics teacher would be a teacher that’s very professional and understands the subject, understands the psychology...the mentality that goes with mathematics. In order for you to teach it you have to understand it, you have to understand the whole idea, the feeling people have with this subject. (ISI, 5:8)

However, Siphó ranked subject specialist above didactics specialist, which in turn was above caring.

#### ***Siphó as Mathematics Specialist***

He explained why Mathematics Specialist was ranked highest in his perception of his PMTI:

I believe that to be able to be sincere and focus on the learners, the subject should be well [in hand] in order to identify what learners understand. Once the subject has been mastered a shift can be made to the process of learning and content towards the learners’ capability and level of understanding. (Q, 2:170)

When asked what he had learnt at university about being a Mathematics Specialist, Siphó did not refer to an increase in or an emphasis on subject knowledge. Instead he spoke of keeping up to date with technological developments: “I still have a lot to learn because the processing of information and the information is increasing everyday new discoveries and advancements are being made in our

modern day and society” (Q, 2:174) He is confident in his knowledge of mathematics and of his ability to deal with any questions that may arise in class. At university he worked in a group with his classmates to consolidate the work done in class each day in an effort to ensure that his mathematical understanding was being extended and that he would have the knowledge he thought he may require in class one day.

### ***Sipho as teaching-and-learning specialist***

When asked about his perception of himself as Teaching-and-learning Specialist, Sipho spoke only of respect for the learners and treating them with respect. He emphasised the importance of understanding the way the learners think and feel. “Teaching is a two way process of communicating, the learners’ views and opinions should be regarded as equally important because it brings about some sort of uniqueness in the learners,” declares Sipho (Q, 2:180). Because of his personal experiences with a teacher who had a derogatory attitude towards certain learners, Sipho is particularly aware of the way in which a teacher speaks to a learner or responds to learner error. He believes that discouragement and demoralisation are inevitable results of a teaching style in which the diversity amongst learners is not understood and accommodated:

INTERVIEWER: What do you think they [the learners]feel?

SIPHO: There’s this trait that they have, especially when they’ve been taught badly by some teachers that are discouraging, if they’re...kept on being discouraged all the time by the way they worked, for example, a sum. If that learner doesn’t understand, now the teacher, instead of giving credit and trying to identify what it is that they don’t understand, will just chuck them down and they will demoralise them even further. They won’t accommodate and meet them half way. (ISI, 5:16)

In his initial interview, Sipho explained that a good teacher should not only make the effort to understand how the learners think, but should employ psychological strategies to set the learners at ease in the mathematics classroom, removing the blockages to understanding caused by fear and discouragement:

Well, I’ve seen some teachers, some mathematics teachers that teach mathematics, some professional teachers- there are teachers that take the psychology into account. They use psychology to get to the learners, to make them feel comfortable with the subject; to make them understand that it’s not just the subject, the subject is about this... (ISI, 5:20)

It would seem therefore, that Siphó's own negative schooling experiences remain influential in terms of who he is as a teacher. His main concern is that he teaches in such a manner that the learners are not put down in any way, that they are encouraged and continually motivated to do better, whatever their mathematical abilities may be.

### *Siphó as Carer*

Judging by the statements he made during the initial interview, Siphó attaches great value to relationships with the learners. For this reason he found that the limited timespan of the practica was inhibiting: "Well, with the time that we were given it was very hard. By the second week you can bond, you start bonding and then the third week you have to go" (ISI, 5:36).

Siphó also believes that a good teacher should be available outside of class time so that a learner may approach him on an individual basis. This he discovered as a learner himself, when he was forced to walk out of a mathematics classroom with many questions unanswered. Sometimes, he feels, understanding is just one more minute of teacher attention away:

There comes a time, a period is so short ma'am, that for the first, let's say it's forty-five minutes, for the first thirty-five minutes you are clueless, clueless and then, just at the thirty-sixth minute you go like "Ah!" but then the minute you were like "Oh, so that's how you do it" and then you want to enquire further, the bell rings. The minute you start enjoying it ... then the bell rings... (SSI, 3:449)

Were he to prioritise the dynamics of the classroom, Siphó declares, "Learners first, content second" (SSI, 3:459)

### **4.2.6.3. Actualisation of Siphó's PMTI**

Siphó's mentor teacher did not prioritise the aspects of his PMTI the way he did. In her opinion, Siphó manifested a concern with the establishment of personal relationships with the learners which outweighed the other categories:

I think he seemed to be more focused on the wellbeing of the learners as well as how they relate to each other in class. He used to talk a lot with the learners individually about their behaviour and performance. As far as the subject knowledge and his presentation skills I think he can still improve a lot on it. (Mentor teacher questionnaire)

### ***Mathematical expertise***

Sipho's mentor teacher, observing him teach on a regular basis, indicated that, despite the assertion by Sipho that being an expert in the mathematical content was most important to him, she witnessed a lack in this area in his teaching. In the video footage Sipho was also seen to make a fairly elementary mistake: in referring to a prime number, he called it a proper number. Generally he presents the mathematical content with confidence and is not at a loss to answer any questions the learners might have. He is unhesitant in his presentation and does not refer to notes or the textbook as he teaches. While there may be gaps in his knowledge of school mathematics as perceived by his mentor teacher, his mastery of the content is adequate. He certainly thinks that he is "covered in that department" (SSI, 3:477).

### ***Teaching and Learning***

When discussing the possibilities of being creative in teaching mathematics, Sipho defined creativity in this context as a focus on visualisation. He clarified this by stating that using shapes or objects to elucidate an explanation was an exercise in creativity. To him, then, being creative has mainly to do with the use of manipulatives. In the video footage Sipho is seen to use objects to hand, even the learners themselves, to illustrate the concept (ratios) that he was explaining. He was persuaded during the methodology classes at university that linking mathematics to the real world or at least to that with which the learners can associate, is a technique that works. Explaining this particular situation as he watched the video footage, Sipho said that it was important to him to try to operate on the learners' level. If this meant using very simple techniques, then that is what he would do.

One thing that he is certain of in his teaching, says Sipho, is that one should adapt one's teaching to the particular audience in question, and that every effort should be made to ensure that each individual experiences the lesson as "fun". That, according to Sipho, is the "psychological part" of teaching:

If you know the content you...teaching is about sharing the content, explaining the content to the learners. So if you are covered in that department then you have to try to make the psychological part of it, how are you going to express it? Are people going to listen to you? If they want to listen to you ...what do you have to do in order for them to listen to you and how will you do it for them to listen to you and to understand it at the same time? (SSI, 3:477)

### **Evidence of understanding**

Understanding, he knows, cannot be guaranteed. He finds that asking questions of the whole group, eliciting choir-type responses provides sound evidence of understanding or the lack thereof. Firstly, he feels that the individual learner remains safe in this type of questioning – he wants to “save their embarrassment” (SSI, 3:215) – and secondly, he is able to gauge the reactions of individuals in the group response: “I want to hear those guys active and from there I notice, why is he quiet? There’s that, it’s sort of like a little study for me, getting to know the learners” (SSI, 3:215). Generally, he uses questions of this kind to access evidence of understanding.

### **Teacher/ Learner-centeredness**

In his determination to keep the learners involved in the lesson, Siphso adopts what he calls a “dramatic” style. This involves walking up and down the class, rubbing his hands together and generally just “talking to them, make them free, set them at ease” in order that

I can show them that this is going to be fun, just takes them away from “Ah, mathematics is so boring! Numbers again”, Make it a little social; make them see it in a social way, more like chatting, talking to me and asking me about mathematics, the actual content, reality. (SSI, 3:271)

This particular style, Siphso explains, does not work for all the learners in the class – some will find it silly:

Some of them, they don’t really approve of the style, they’re like “ok, he’s a clown” but then you can easily pick that up from a learner that he thinks “ok, he’s a clown. He’s wasting our time”. You always want to be challenging, normally that learner will always be quiet. (SSI, 3:316)

Were he to perceive such a reaction, Siphso says he is able to adapt his teaching style so that all the learners remain engaged:

Get more serious, more serious ...and the tone of voice should change, tone should change. More eye contact towards him, get him involved, ask a lot of questions, try some ideas, let him explain rather than me talking, see that he knows something and he wants to...to share something, let him explain. Let’s see how he does it and then from there I incorporate it to the others so that I can accommodate everyone. (SSI, 3:320)

Involvement of learners, to Siphó's way of thinking, includes allowing them to teach and to be given the opportunity to demonstrate their understanding of a concept. In the video footage, he is seen to invite a learner to explain her answer on the board.

That girl that came up there, I remember, she was the one that was busy. She was all of the time asking, asking so then I wanted to see what she knows, I wanted to find out more, give her the chance because she was...she was jumping up and down, jump...jumping for attention, so I gave it to her, satisfy all their needs, try at least to satisfy all their needs. She wanted to be seen, she wanted to present something to all of us, so give her the opportunity why not and see where it goes. (SSI, 3:292)

In the video footage, Siphó invites learners to participate freely in the lesson, often at the cost of discipline in the classroom. His approach is visibly friendly and jocular: it would seem that his primary strategy is to make the learners enjoy being with him in the class. Part of this strategy implies a negotiation of meaning in the actual content of the lesson: he strives to draw information from the learners by asking questions and prompting them to access the prior knowledge they might have to be able to do the work at hand. He also tried to make the work relevant to the everyday lives of the learners: for example, in teaching about ratio, he used the demographics of the classroom to illustrate comparisons.

### **Flexibility**

His knowledge of the topic in general was broad enough to allow him flexibility in the course of the lesson. For example, he was talking about a ratio of rands and cents, and required the learners to make everything "of the same kind". When some of the learners showed that they were uncertain about the direction of movement of the comma in this conversion, he digressed from the plan of his lesson to expound briefly on place value.

This flexibility is invaluable, according to Siphó. The purpose for planning a lesson, according to Siphó, is to "organise yourself". This involves deciding on "How to present the lesson, make it enjoyable, to come up with new ideas all the time, keeping it fresh" (SSI, 3:356). While the lesson plan provides the basic structure of the lesson, it does not necessarily determine how the lesson is presented: "a different audience and you present it differently. It ...it all boils down to...to the...to the audience, how they respond" (SSI, 3:356). Such factors as the weather, classroom logistics and



the general mood of the class all have to be taken into consideration in presenting a lesson, and that, as Siphso explains, means that flexibility in teaching is the order of the day, since one can never be sure of these things in advance. Whatever the plan for a lesson, if he discerns difficulty and a lack of comprehension, Siphso believes that the plan should be abandoned in favour of another explanation:

SIPHOS: You can't advance ma'am, you can't advance. If...if they fall behind you cannot advance to the next...next...next step, you can't. If they don't understand this part here, I always like to think about it...I always love to use uh, what was it? van Hiele?

INTERVIEWER: Yes! van Hiele levels.

SIPHOS: Yes, van Hiele level like that. I always think about it, if...if you're still at zero, you come off to one. So, equally, if you don't understand what I'm talking about now, I shouldn't leave you behind...shouldn't leave you behind.

INTERVIEWER: Ok, so you think it's worth stopping ...?

SIPHOS: It's worth it, it's worth it. (SSI, 3:380)

### **Evidence and purpose of caring**

Siphso believes that caring implies encouraging the learners and not "crushing" them in any way. Therefore, when an incorrect response is offered by a learner in the video and the class is seen to laugh, he stops the laughter because "I don't want to hurt their feelings, I don't want them to, just because they've answered wrongly or said something which is out of context, to not be involved in the classroom anymore" (SSI, 3:119). It is therefore important to him that the learners feel safe enough to continue to participate in the lesson because, he says, "they all have to contribute something in the classroom" (SSI, 3:231).

Perhaps because of his experiences as a learner, Siphso is tremendously culturally aware. He therefore dedicates time and thought to dealing with cultural diversity in the classroom, despite the difficulties involved:

So with the white learners I had to be extra careful by what I say - choosing the right words, try to perfect the English, which is very hard especially when you have to think on your feet. The treatment, I tried to treat them all equally but now, some of the white learners that may be advancing in the subject, they will try and make a mockery out of the whole lesson. They won't

respect other learners, they won't respect other learners' answers and they won't respect you when you respond to them. (ISI, 5:112)

His belief that skin colour is a barrier to be overcome in the classroom seems to carry the same weight that language does. His home language is not the same as that of most of the learners in Pretoria. He therefore has made a huge conscious effort to become familiar with the more common local languages so that language differences do not constitute an obstacle in his practice. This is important to him, despite the fact that all tuition in the classroom takes place in English.

SIPHO: Yes, I use multiple methods, Ma'am, because the learners are very different. First of all: the culture, our cultures are very different and the language that we speak.

INTERVIEWER: What do you mean by cultures are different?

SIPHO: I'm from mostly rural background and...

INTERVIEWER: What is your home language?

SIPHO: Seswati and here it's mixed, it's mostly Tswana and Sepedi and Sotho.

INTERVIEWER: Can you speak their language?

SIPHO: I can hear [understand] it and I try, but I'm not that fluent yet. So with the language, taking just the language into account, I try to accommodate them. But in most cases you find that they will use their language most of the time and they will try to express themselves in their language - I do not discourage that, instead I use that, I give them the stage. One of the learners in the classroom might know English, might know how to translate it. Instead of showing them that maybe I do not understand in this particular sentence that you mentioned and how you express yourself, I would use that learner to explain to the class as if one of the learners didn't understand, because you'll find in the classroom that one of the learners *don't* understand. So I'll use methods like that just to come around, work around that. (ISI, 5:52)

Sipho's main concern, it would seem, is that all his learners recognise that he treats them equally and respects their cultural and language differences. It would appear that the actual mathematical content of the lesson takes second place to this concern.

#### 4.2.6.4 Summary

Sipho was driven to prove to himself and his erstwhile teacher that he could not only *do* mathematics, but that he could *teach* it; and that he would demonstrate that racial prejudice is taboo

in any classroom. His tertiary training changed and shaped him: in particular, he found that Educational Psychology opened his understanding as to how learners actually learn and how teaching should be adapted to accommodate learning styles. He recognises three influences that shaped his style: his schooling experiences, the modules he was taught at university, and the views and understandings of his peers. Teaching practice gave him the opportunity to ‘try out’ his newly developed style, under the aegis of mentor teachers who he recognised to be sources of knowledge. However, he found that there was a discrepancy between what he was taught at university and what he experienced in the reality of the school. The theory had not quite prepared him for the practice. He did his teaching practica in former Model C schools in Pretoria, where his classes were racially mixed. He found that he had to prove to the white learners that his knowledge of mathematics and his ability to communicate that knowledge were more relevant to the classroom than his skin colour. His view of mathematics seems to fit into Ernest’s (1988) Problem-solving category. He sees the subject as involving logic and reasoning with a view to deciphering the links between mathematics and the real world. His view includes a non-concrete, non-finite aspect – “the art of science” which makes it both beautiful and mysterious, something to be explored.

Figure 10 is a visual representation of Siphos’s PMTI. It is clear that he is confident in his usage of mathematical concepts and teaches the topic at hand with ease and comfort, without making major mathematical mistakes. However, his mentor teacher observed that his knowledge of mathematics required further extension. Siphos *believes* that being a subject specialist carries the greatest significance in his PMTI, but evidence of this practically being the case is absent: both his mentor teacher and the video footage indicate that he is more concerned with making his learners feel comfortable in his class so that they can be free to participate in the lesson. He also believes that learners have a negative attitude towards mathematics which needs to be addressed. In describing a good mathematics teacher, he said that, “In order for you to teach it you have to understand it, you have to understand the whole idea, the feeling people have with this subject.”

He sets great store by the by his knowledge of educational psychology which allows him to understand what the learners think and feel. To improve understanding, he likes to use manipulatives. These can be any object to hand that may be used to illustrate a concept – whatever it takes to get to the learners’ level. He also wants his classes to be fun, a strategy he believes makes

learners *want* to be attentive in his class. He is concerned about shy or reticent learners and this is one of the reasons for which he uses choir-response questions- it allows the shy learner to remain hidden. However, he says he is able to gauge the reactions of individuals in the group response: he can see who is not participating and then proceeds to find out why. The teaching strategies he employs he describes as “dramatic”, and include walking up and down the class making large gestures with his hands. He believes this sets the learners at ease – making the atmosphere more social, if a learner seems to disapprove, he is able to become more serious – thus keeping all the learners engaged. He believes it is useful to allow the learners to teach from time to time: for this task he selects learners who seek attention or approval. In this way he is able to satisfy the need of the learner, while at the same time finding out what such a learner knows. Sometimes class discipline is sacrificed in his application of these strategies. He does not perceive this as a problem, as long as he is able to draw the learners out to reveal their prior knowledge and to lead them in constructing their own understanding. He plans his lessons in order to be organised, but believes in being responsive to the “audience” – if deviation from the plan is necessary, he will do so. In terms of Ernest’s (1988) categories, he is a facilitator. He is driven to facilitate relationships and cultural respect. He wants to please, and to be liked and accepted by his learners.

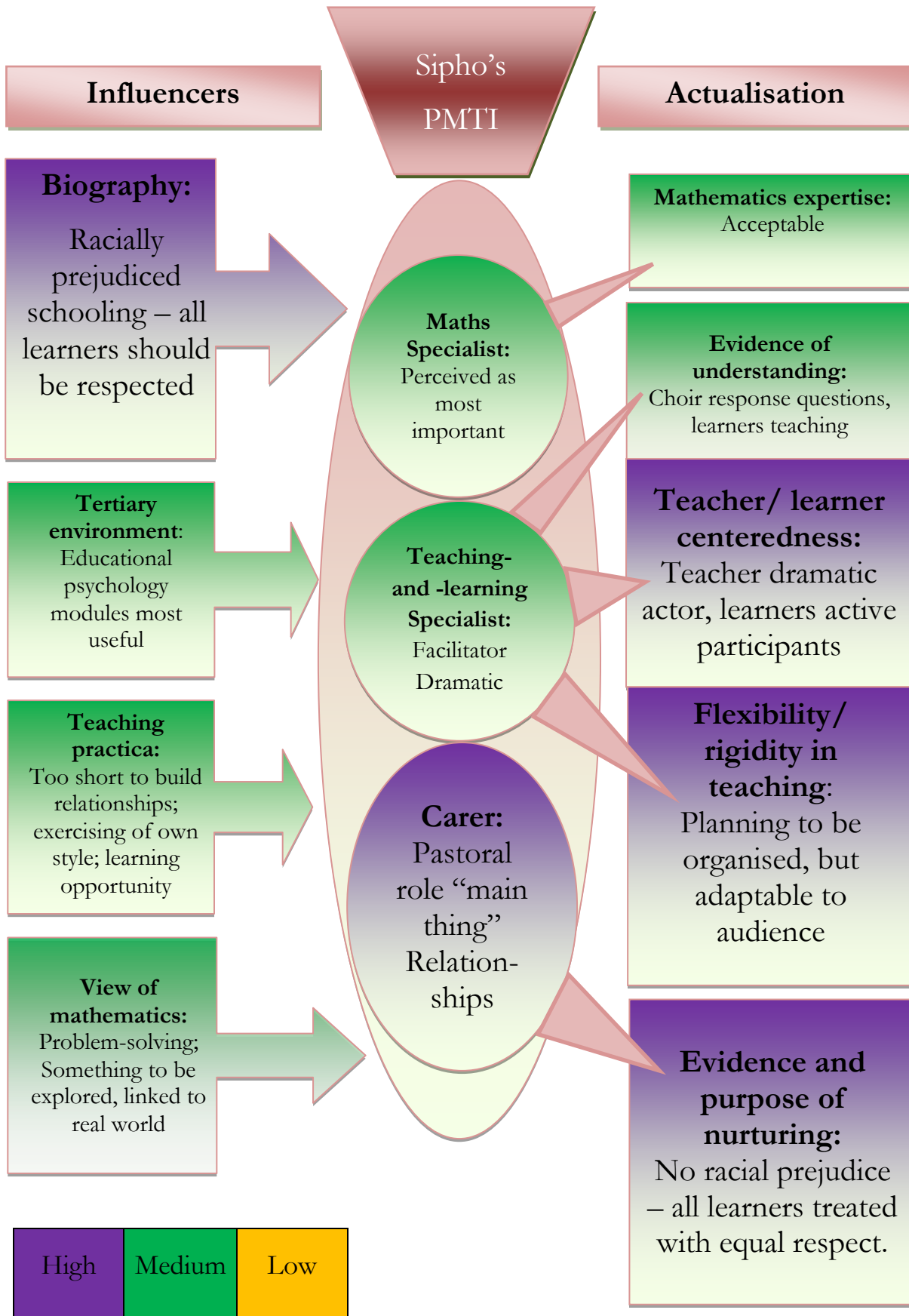


Figure 10. Sipho's PMTI according to the Conceptual Framework