Chapter 4
Using Self-Study to Learn to Teach Genetics to Pre-service Teachers for Understanding and for Teaching

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Introduction

According to Loughran (2006) teacher education has two important foci: learning about teaching and teaching about teaching. The task of the pre-service teacher (PST) is to develop knowledge and skills for teaching and how to competently apply these in practice and that of the teacher educator is to teach about teaching that is the knowledge and skills of teaching. A survey of the Self-Study of Teacher Education (S-STEP) research literature shows that the focus of most of the research that has been done was on teaching about teaching in methodology courses (e.g. Berry, 2008; Bullock, 2011; Loughran, 2006). There is very little research on teaching about teaching when one is teaching content subjects like mathematics, science and geography in pre-service preparation programmes. Central to this chapter is the argument that teaching about teaching should also happen when teaching content subjects to pre-service teachers. Teaching about teaching when teaching content subjects is important for the improvement of practice in Higher Education Institutions where the model of teacher education is such that teacher educators are also responsible for teaching content courses.

When we look at teaching in teacher education contexts, teacher educators and the students of teaching should practice what Russell (1997) describes as the 'content turn' and the 'pedagogical turn'. The content turn focuses on knowledge of the discipline of teaching such as knowledge of classroom management, higher order questioning, constructivism and cooperative learning (Loughran, 2006). The pedagogical turn is when teacher educators consciously think about how they teach the content and the messages that are conveyed by their teaching (Russell, 1997).

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According to Loughran (2006), teacher educators and the students of teaching have been seen to focus all their attention on the content turn without paying much attention to the manner in which that content is taught; the pedagogical turn. While this observation was made in the context of teaching about teaching, I see it as also happening in contexts where teacher educators are teaching content subjects. The purpose of teacher education is to educate teachers and therefore whether you are teaching about teaching or you are teaching content subjects, both the content and how that content is taught are important as both elements influence how the PSTs will teach when they become practicing teachers. How subjects in the school curriculum are taught is important to PSTs, as most of a teacher's time is spent teaching these subjects, especially in high schools. Loughran (2006, p. 4) argues that:

> At any given time in the teaching and learning environment, there is a need to be learning that which is being taught while at the same time questioning, examining and learning about the way in which it is actually being taught: asking questions about the nature of teaching, the influence of the practice on the subsequent learning (or lack thereof); the manner in which the teaching has been constructed and is being portrayed; how the teaching-learning environment has been created and so on.

From this argument, it follows that PSTs' learning agenda should always include both learning the subject content and learning about teaching that content and the agenda of teacher educators should also always include both teaching the subject content and how that content should be taught. However, according to Loughran (2006), focusing on both agendas is not easy. For the majority of the students, focusing on content is what they had been taught to do in the 12–13 years of formal schooling. In addition, the teaching that is done in universities sometimes reinforces a focus on content while ignoring pedagogy. It should therefore be the responsibility of the teacher educator to help PSTs to focus on both agendas in order to achieve the dual purposes of teacher education. The question however is: Are teacher educators aware of this responsibility and professionally equipped to undertake it?

Recent research indicates increasing awareness of the importance of focusing on both content and how that content is taught in the methodology courses (e.g. Berry, 2008; Bullock, 2009, 2011). Unfortunately, the same cannot be said about the teaching of content subjects. Research literature shows that when teaching content subjects, teaching content is all too often the only focus of attention for many teacher educators (e.g. Garbett, 2012; Tidwell & Fitzgerald, 2004) but good teaching when teaching content subjects to pre-service teachers requires a consideration of both agendas; teaching the subject content and how that content can be taught most effectively. The objectives of this chapter therefore are to report on a self-study in which I investigated my own teaching of a biology content course; genetics to pre-service teachers. The questions that guided my study were:

1. How can I teach a genetics content course to PSTs for understanding of content and for teaching it?
2. What are PSTs' experiences of my teaching and what do I learn from those experiences?

In attempting to address the two agendas of teacher education in my teaching of genetics to PSTs, I decided to use a modelling teaching approach (see LaBoskey, 2004; Loughran, 2006). According to Loughran, there are two forms of modelling teaching in pre-service teacher preparation. The first is the "traditional" form comprising of demonstration of teaching practices from which students are expected to learn by observing the teaching that is occurring. In the second, in addition to demonstrating the teaching practices, PSTs are offered access to the thinking and knowledge underlying a particular teaching approach, teaching and learning (T/L) aids or teaching procedure (Loughran, 2006). The unpacking of the teaching process is done so that PSTs access pedagogical reasoning, uncertainties and dilemmas of practice. Loughran considers the second type of modelling to be more effective when teaching about teaching. However, when teaching a content course, it is possible that the traditional form of modelling teaching can be equally effective especially if we consider the claim by Russell (1997) that HOW we teach is the message that students get from our teaching. In the self-study discussed in this chapter, I used both forms of modelling in my teaching of a genetics course. I aimed to teach in a manner that demonstrated aspects of 'good' teaching such as effective use of audio-visual aids and use of a variety of teaching styles without explicitly revealing to students the thinking and pedagogical reasoning behind the teaching that I was doing. In some cases however, I explicitly stated and explained the pedagogical reasoning behind my teaching practices. The term 'good' is placed between inverted commas because I agree with Fitzgerald, Dawson, and Hackling (2013) that good teaching is difficult to define as what is considered good depends on the experiences and opinions of stakeholders. In this study, I viewed good teaching in a pre-service teacher preparation programme as including features of teaching which could assist and enable pre-service teachers to acquire and understand the content knowledge of genetics and at the same time to acquire skills and competencies for teaching that content. In the next section, I outline the context in which the research was situated.

The Research Context

University of the Witwatersrand School of Education (WSoE)

The WSoE was the context of the self-study that is discussed in this chapter. The WSoE uses the concurrent (CC) model of Initial Teacher Education (ITE). In ITE, there is an academic component in which PSTs study content subjects (also referred to as subject matter knowledge) of one or more academic subjects and a professional component where students study educational theory and knowledge for teaching content. In the CC model, the academic component is studied alongside the professional component throughout the 4 years of the programme. PSTs who complete this programme successfully graduate with a Bachelor of Education

degree. In the WSoE, teacher educators teach both the professional component and the general component. The aim of this CC model is to give PSTs deep knowledge and conceptual understanding of content knowledge and to teach them the professional component in close alignment with the teaching of the academic component. Courses in the professional component include general pedagogy and discipline specific methodology courses. Discipline-specific methodology courses aim to show pre-service teachers how to teach a specific academic discipline or subject. An example of such is Secondary Methodology Life Sciences, a course in which topics include planning for lessons, doing practical work and different forms of assessment are taught. Although the programme delineates the teaching of methodology courses in relation to PSTs' academic majors, the teaching about teaching that is done in the methodology courses is not in most cases linked to specific content that is taught in the academic course.

The Genetics Course

The genetics course which was the focus of my self-study is a third year course offered to PSTs who are taking Life Sciences as their major and fourth year pre-service teachers who are taking Life Sciences as their sub major. It is a 6 week course allocated seven 50 min periods per week. In this course, I use three periods (one single and one double) for teaching, one period for a tutorial and the last three periods for a practical session. The genetics topics that I teach include molecular level genetics (DNA, chromosomes, genes), meiosis, genetic inheritance, genetic diseases and genetic counselling and testing. In tutorial periods students answer questions based on content from the three teaching periods with guidance from a tutor and also engage in other activities such as role playing and presentations. In the practical session, students undertake microscopy or the modelling of biology phenomena.

South African School Contexts

The focus of this study was the teaching of genetics to PSTs who were training to be high school life sciences teachers in varied school contexts (I briefly describe these school contexts as knowledge of these contexts influenced the way I modelled my teaching of genetics to these PSTs). In South Africa, schools may be located in rural settings, township settings, suburban settings or informal settlement settings. Many rural schools are poorly resourced and lack even basic facilities such as furniture, electricity and running water. Township schools and those in informal settlements are often characterized by large overcrowded classes and many learners in

these schools are from poor socio-economic backgrounds. Suburban schools can be public or private. Public schools are run by the government and some of them are well managed with adequate resources and others are poorly managed. Private schools vary from high fee paying schools with state of the art equipment and resources like smart boards, data projectors and computers with internet access to medium to low fee schools with correspondingly fewer resources. The PSTs that we train can find themselves teaching in any one of these school contexts after qualification.

Pedagogical Content Knowledge: Theoretical Framework

The theoretical framework that guided my study was the Pedagogical Content Knowledge (PCK) framework originally conceptualised by Shulman (1986). I chose and adapted the PCK model of Davidowitz and Rollnick (2011). The model is divided into two sections; the upper and the lower sections. The lower section consists of four domains of teacher knowledge: knowledge of subject matter, knowledge of students, general pedagogical knowledge and knowledge of context. This lower section also includes a teacher's beliefs as an underpinning factor that influences a teacher's knowledge domains and vice versa. The knowledge domains amalgamate to produce PCK which then manifests in different forms in the classroom during teaching. The upper section of the model consists of the manifestations of teacher knowledge. The self-study that is reported in this chapter was about my teaching and students' learning in pre-service teacher preparation. Therefore, I used the PCK model described above in my context as a teacher educator. The first aspect of the framework, which is the teacher's beliefs, represents what I believe as a teacher educator to be good teaching and to be important for good teaching to occur in pre-service teacher preparation. I viewed the four knowledge components in the model as aspects that could guide my planning for effective modelling of teaching to occur. However, I expanded the knowledge components so that they could inform my investigation by considering that as a teacher educator, in order to fulfil the two agendas of teacher education in my teaching of genetics to PSTs, I needed to have knowledge of:

1. My context which is teacher education and my students' future contexts which are the schools.
2. Students in my classroom (PSTs) and knowledge of PSTs future students.
3. The genetics that I needed to teach PSTs and PSTs will teach in schools
4. Pedagogy appropriate for teaching genetics to PSTs and for teaching it in schools.

I anticipated that knowledge at these dual levels would enable me to teach PSTs genetics for understanding as well as for teaching it after qualification.

Research Design

My concern was how to teach genetics to pre-service teachers in a way that would fulfil my dual responsibility as a teacher educator; teaching content and teaching about the teaching of that content effectively. I used both forms of modelling teaching in pre-service teacher preparation as a way of teaching content for understanding and for teaching.

Participants

With the methodology being a self-study, I was the main participant. Two colleagues and 13 PSTs from the 91 PSTs in the class were also participants. Purposeful sampling of the 13 PSTs was done so that I would have participants who were representative of the diversity of PSTs in the course in terms of gender, race and ability. PSTs' marks in the course were used to determine the ability levels. A total of 33 PSTs had consented to being interviewed. Of these 33 PSTs, 13 were eventually interviewed. The details of the participants are shown in Table 4.1 below.

Data Collection Methods

As is necessary in self-study, data came from multiple sources (Samaras, 2011). The data included detailed teaching plans; journal entries of my observations during teaching periods and reflections; audio transcripts of conversations and discussions with colleagues and critical friends, videotapes of the teaching periods and interviews with pre-service teachers about their experiences of my teaching. Journaling and discussions with critical friends were continuous processes throughout the research process. Below I describe and give examples of the forms of data collected.

Table 4.1 Details of participants

Participant category	Participant description
Self	Teacher educator responsible for teaching the genetics course to 3rd and fourth year pre-service teachers
Colleagues	Tondi and Belinda (pseudonyms), professors in the Department of Science and Technology Education responsible for teaching evolution and biotechnology courses. Tondi was also one of my critical friends
Pre-service teachers	7 females: 4 African, I Indian, 1 Coloured, 1 White 6 males: 1 Coloured, 4 Blacks and 1 Indian

Descriptions of My Teaching Plans

Below is an excerpt of my planning in which I described in detail how I was going to approach my teaching. The description is an extract from my plan book. For the purposes of this study I was describing in detail my planning including my reasoning.

> *I am going to incorporate in my teaching aspects from all the four domains of knowledge*: *knowledge of content*, *knowledge of students*, *pedagogical knowledge and knowledge of context. Examples of these aspects include the use of assessment activities and teaching and learning* (*T/L*) *aids that students can also use in their future contexts as teachers. Instead of only using a PowerPoint presentation*, *I will also prepare and use charts with pictures and diagrams*, *the same pictures that I would show in my PowerPoint presentation just to provide a different way of presenting content to students. I will also make use of the chalkboard in some of my lectures where I will come in early and draw some diagrams on the chalkboard and make reference to these during the teaching sessions. During feedback sessions*, *I will also write students' responses on the chalkboard*.

The use of charts and T/L aids and simple formative assessment methods were meant to be a way of modelling some good teaching practices to pre-service teachers in a way that would enable them to learn the content and at the same time to learn about the teaching and assessment of that content.

Journal Entries

I used journaling to document my thoughts and insights as I was planning, preparing and reflecting on my teaching. Below are examples of the journal entries. The first was written when planning to teach meiosis. It was a question that I intended to discuss with a colleague.

> *How does one teach in a way that goes beyond just describing the phases of meiosis*?

Next is a transcript of the dialogue I had with Tondi in response to the question above. To put Tondi at ease, I first described how I had taught meiosis then asked how he would teach it.

> *When I teach meiosis*, *I just describe the different phases. How would you teach it in a way that goes beyond just describing the phases*?
>
> *Tondi*: *If I had been teaching this ten years ago and I wasn't thinking in detail about it*, *I would have taught it in the way you have just described it but now because you are asking us about it and we know that you are doing this study*, *it's like we are meta-thinking about it. It's like metacognition. We are thinking deeply. I would suggest that you teach conceptually working out with them what would happen if for example ordinary cells of an organism with four chromosomes in each cell are used in sexual reproduction as sperms and ova*.

I also wrote journal entries about my observations, emotions and feelings before during and after the teaching periods. Below is an excerpt illustrating my emotions after a class in which I had invited a person with cystic fibrosis to share her

experiences of living with the disease. On this day, towards the end of the lecture, one student walked out.

> *Today a student walked out of my lecture when a guest was making a presentation. That was very rude and inconsiderate. This person made a lot of effort to prepare for this class and you just decide to walk out on this particular day. Was it boring? Did he feel it was a waste of time? I am going to confront him to find out why he walked out.*

Entries like the one above would be presented to a critical friend for mediation of my thoughts and my reflections on the incident. I used the term trigger incident (TI) to describe observations like the one described above that triggered something in me such as thoughts, feelings and emotions that initiated a response and also prompted me to reflect on what was happening during my teaching of the genetics course.

Dialogue with Critical Friends (CFs)

Self-study requires constant dialogue with critical friends for purposes of mediating and critiquing one's work. By including critical friends in my study, I aimed to increase my awareness of what I could have been taking for granted in my teaching. At the same time, conversations with critical friends provided opportunities for support (Brookfield, 1995; Samaras & Freese, 2006). I however faced a challenge in regard to this important component of my self-study. It was difficult to find a colleague who understood the role of a critical friend and who was willing to commit to playing that role considering not only the demands of time for watching videos, listening and reading the work but also the challenges of critiquing a colleague's work. During the study, I worked with four critical friends. Having multiple critical friends increased the chances of getting my work critiqued in time for the next session. I present in Table 4.2 below how my four critical friends were involved in this study.

The use of a diverse group of critical friends contributed to a rich mediation and critiquing process. Below are two comments from California and Nico which are an

Table 4.2 Details of critical friends and their involvement in the study

Critical friend	Designation of CF	Description of CF's participation in the study
California	A professor in Science Education	She responded to journal entries, reflections, video tapes and interview transcripts
Tondi	Professor in Science Education	He critiqued my planning, reflections on my teaching and the analysis of my teaching and PSTs' interviews
Georgia	Colleague in the Department of Science and Technology	She critiqued my teaching
Nico	Professor in English at another institution	He critiqued my teaching and responded to the interview transcripts

example of the diversity of opinions of these critical friends. These comments were in response to comments made by PSTs about my teaching.

California: *Wow*! *I want to know what you did in your teaching that resulted in students giving such comments. You should articulate it as it positively impacted students' learning and will likely impact the teaching of others*.

Nico: *Why are there no tensions and contradictions in your teaching to make the whole thing credible*? *You would need to analyse your quotations in detail to bring about the hidden meaning behind all those nice words students say about your teaching*.

The critique from California and Nico shows two extremes. California was not concerned that comments from students were entirely positive and wanted me to articulate what I had done and share with a wider audience. Nico, however, was concerned about the possible superficiality of the comments and wanted me to dig deeper into possible hidden meanings.

Video-Recording of Lectures

I video-recorded all 18 teaching periods so that my teaching could be available to critical friends for critique. The video-recording focused only on myself as some students had not consented to being video-recorded. The video captured everything I did and said. Video recordings recreated the teaching situations which offered my critical friends and myself opportunities for post-event scrutiny. The audiotapes were transcribed by a professional transcriber. After transcription, I made the videotapes and audio transcripts available to Georgia and California who had agreed to critique my teaching. On one occasion, I sat with California and together we watched a whole 1 hour video of my teaching. The questions that guided the critiquing of my teaching were formulated around my first research question. The questions were:

1. What teaching practices are evident in my teaching?
2. To what extent are the teaching practices models of good teaching?

The answers to these questions formed part of the critical analysis of my teaching by my critical friends, the results of which are presented in the findings section.

Interviewing Pre-service Teachers

I used a semi-structured interview schedule which was adapted from a practice-based research project which was running in the institution at the time and piloted it to ensure its suitability for my study. The interview schedule allowed pre-service teachers to comment on: my teaching; the course content and skills; lessons learnt; usefulness; and enjoyment. Interviews were conducted with PSTs in small groups rather than with individuals. The pilot study showed that group interviewing created a relaxed atmosphere in which the PSTs could express their responses to the course freely. In addition, responses from group members acted as a stimulus that

facilitated recall by others. 12 of the 13 PSTs were interviewed in four groups. One PST was interviewed alone as she was not available at the times that other students had indicated their availability.

The Interrelationship of the Data Collection Methods

Figure 4.1 below shows how the methods used were interrelated and added up to a rich data set that helped me to answer my research questions. The arrows in Fig. 4.1 indicate how I made use of the data. For example, the arrow labelled 1 shows that I collected data in the form of teaching ideas from my interaction with colleagues. I then presented my thinking about those ideas to my critical friends for their input. The arrow labelled 2 shows I collected data, again in the form of teaching ideas, from my discussion with critical friends and applied it to my teaching. Dotted arrows indicate that only some teaching ideas from colleagues were discussed with critical friends and implemented in my teaching. The thicknesses of the edges of boxes and of the arrows are representative of the quantity of data; the thicker the edge or arrow the bigger the contribution from a particular data source. All five data sources in Fig. 4.1 have been given alphabetical codes for ease of reference in the explanation below the diagram.

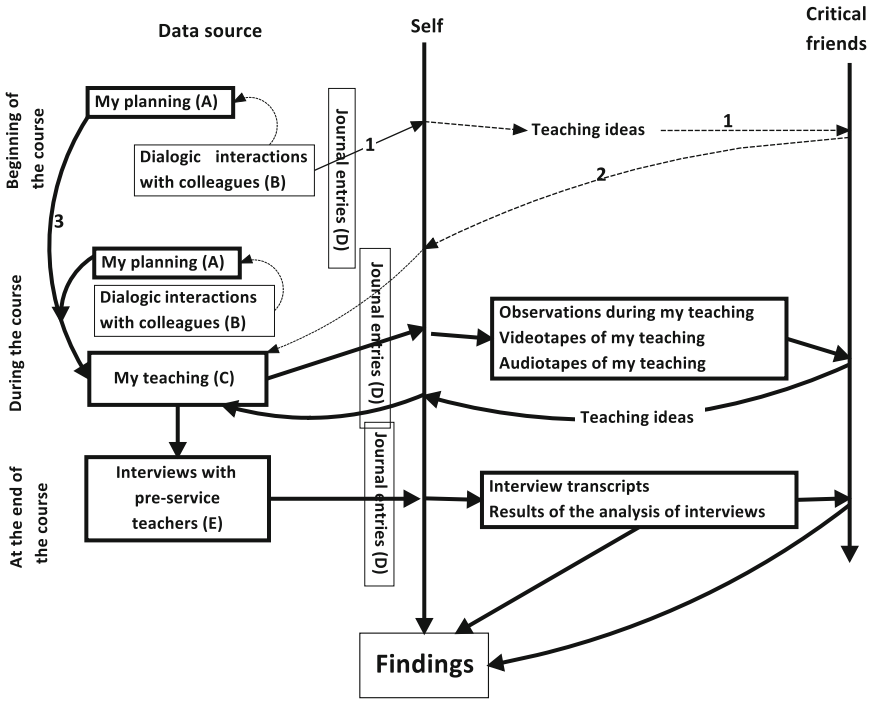

Fig. 4.1 The interrelationships between the various methods of data collection used in the study

A was my first data source and it guided my teaching. **B** was my second data source. From **B**, I developed teaching ideas some of which I discussed with critical friends and incorporated into my teaching. **C** was my third source of data from which I collected observations notes, videotapes and audio transcripts. These data sources enabled critical friends to mediate and critique my teaching. **D** was my fourth data source. I made entries in my journal of experiences, insights and reflections from data collection activities. **E** was my fifth data source. The interviews focused on my teaching which was guided by my planning and inputs from colleagues and critical friends. The different data sources contributed cumulatively to findings. For example, data from **A** and **B** fed into **C**; what happened in **C** in turn influenced what pre-service teachers said in the interviews. Being a self-study, my critical friends and I were involved from the beginning of the data collection process to the findings; hence, the two downward arrows from self and from critical friends. Although, I was at the centre of the whole study, my critical friends were also involved throughout the study supporting and critiquing my work.

Data Analysis

Analysis of Trigger Incidents

As described earlier, the events that I described as TIs were events that activated my thoughts, feelings or emotions, what Mason (2002), referred to as sensitivities and prompted me to reflect on what was happening in my teaching. I recorded seven TIs during my teaching of the genetics course. The first TI was about the responses to a teaching activity that I got from PSTs in my introductory lecture that I had not anticipated. The second was the non-participation in discussions of two PSTs Regina and Dylan. The third was the refusal by two PSTs Simba and Kuda to participate in whole class feedback sessions for fear that they would be ridiculed by fellow PSTs if their answers were wrong. The fourth was my failure to understand Fadzi's question (one of the PSTs). The fifth was when a PST (Walter) walked out during a presentation by a guest lecturer which I then perceived as rudeness. The sixth was a comment by a PST which showed his thinking that as a lecturer I no longer needed to read in preparation for lectures as I now know the content. The last was about the two PSTs Simba and Kuda who earlier in the course had refused to participate in whole class feedback sessions for fear that they will be ridiculed by fellow PSTs but later in the course participated in the role-playing activities without a problem. These are some of the events that made an impression on me and prompted me to reflect. Analysis of these TIs involved both California my CF and myself and was done as close as possible to the time when they happened. We would meet and immerse ourselves in the data (descriptions of the TIs). To guide the analysis of the TIs, we used the same questions that I used for the analysis of videotapes:

3. What teaching practices are evident in the TIs?
4. To what extent are these teaching practices models of good teaching?

During the discussion, we would identify the teaching practices and discuss them. We would also discuss my thinking and my experiences of the incidents and my CF's own thinking about the incident. After each discussion, I would record in my journal the teaching aspects identified and how they model good teaching practices. Below I use the first TI to illustrate how we analysed the TIs.

The Description of the First TI: Unanticipated Answers from Students

I used an image to introduce the genetics course. In the image were a population of people, a man and a woman coming out from the population to become a couple. From the man and the woman the image showed illustrations of meiosis, sperm and egg, and what happens from the time a sperm fertilizes the egg to form a zygote until a child is born. When I asked students to tell me what they could see in the image, I had expected straight forward answers from the PSTs; that they could see a group of people, a couple/a man and a woman, a cell, a group of cells, a child. However, the answers that PSTs gave were different to the ones I had expected. One PST said she could see reproduction taking place. Another PST said she could see that the child was different to the parents. When I got the second answer, I felt the urge to say to the PST "but you can't see that on the picture" but I decided to wait and hear all the answers from the PST. To my surprise, all the answers that the PST gave were different to the answers I had expected. These unexpected answers marked a moment for reflection.

When I presented this incident to California, the first thing she said was:

> *Before we look at what happened in this incident, what I see is that you care about the students. This is because by looking for a visual aid in the form of a picture to help students to understand the content that you were going to teach is an act of caring for the students. Therefore caring is the first aspect that I can identify from this incident. It is not a teaching practice but a human characteristic that I think all teachers should embody.*

As can be seen in California's response, the analysis was not confined to the two questions above but was open to all possibilities. After California's first input above, we went on to discuss other teaching practices that were reflected in the incident description. One such practice was that I had used a visual aid, the picture to support my teaching and PSTs' learning. The other teaching practice that I was able to identify with the help of my CF was the application of the tenets of constructivism as explained by Ausubel (1977) from the way I had used the picture. The use of the picture had helped me to identify prior knowledge that PSTs had that is linked to genetics such as reproduction and variation. The picture had also acted as an advance organiser which helped PSTs to identify important genetics concepts and the relationships between them.

The account above illustrates how the analysis of TIs was carried out. The TIs were analysed as close as possible to the time they had happened.

Analysis of My Teaching

Analysis of my teaching involved coding video transcripts. Although I was open to any interesting aspects that I could find about my teaching during the analysis process, my main focus was to find out if I had modelled teaching to PSTs that covered the four domains of a teacher's knowledge namely knowledge of context, knowledge of students, PK and knowledge of content. Therefore, I commenced my analysis with what Berry and van Driel (2013) called a priori system of codes and categories. I developed the codes from my theoretical framework and literature. Below are a few examples of the codes I developed and their definitions.

TP: **Teaching procedure**. Method of teaching that I used to bring about a teaching and or a learning activity e.g. group work in which each group member is allocated a specific role and feedback session.
TA: **Teaching activity**. What I did as part of my teaching e.g. explaining a concept, describing a process
TS: **Teaching strategy**: Describes the development of an overall approach aimed at achieving a specific behaviour, attitude or lesson in students
T/L aid: **Teaching and learning aid**: device, object, material that I used to present information to students with the aim of promoting students' understanding of the content e.g. pictures, diagrams, models and charts

Below is an example of a coded video transcript of my teaching

1. Lecturer put up some questions on the screen at the beginning of the lecture. (**Teaching Procedure-TP/TS**)
2. Lecturer gives instructions to students to discuss the questions in pairs (**TP**)
3. Lecturer puts up a picture on the screen- (**T/L aid**)
4. Lecturer invites students to look at the picture and asks them to say what they can see-**Lecturer Student Interaction** (**LSI**)
5. Lecturer takes responses from students and writes them on the chalk board-(**LSI**)
6. Lecturer repeats the question and waits for more responses-(**LSI**)
7. Lecturer moves on when no more responses are forthcoming-she **describes** in detail what the picture is showing-reproduction, meiosis, mitosis etc. (**TA**)

After coding the video transcripts, I assigned codes to the four categories of knowledge about teaching that I had derived from my theoretical framework namely knowledge of context, students, PK and content.

Analysis of Interviews

Analysis of interviews involved coding the transcripts. The coding was both deductive and inductive. I began the coding with the same codes that I had developed for analyzing my teaching and developed more codes as the coding progressed.

After the coding process, I created categories and subcategories. Below is an illustration of the coding process. The codes are underlined.

Servie Well after Mrs Nyamupa's lectures I think I now understand what genetics is, (outcome of my teaching practices) I understand better than high school (outcome of my teaching practices) because you know in high school I had a very very bad Life Sciences teacher (evaluation of high school teacher). The genetics course was something else. Especially when it comes to the hybrids, the crossings and stuff (description of content), the teacher used the textbook and then he would read everything from word to word (description of the high school teacher's teaching procedure) and then couldn't even interpret some of the things, (evaluation of high school teacher's teaching) so I think Mrs Nyamupa was the best ever, I understood the topic better (evaluation of the lecturer)

Agnes We were able to visually see ourselves, (outcome from practical work done) we were able to create things ourselves, to give everybody an example of what… like with the Reebop that of just mixing it up and making something out of something, (outcome from practicals) it just made it easier to understand maybe how it works in the body and so forth (outcome from practicals)

Agnes As a teacher (identity) it's of being prepared, (outcome lesson about teaching-preparation), of not having just one example or one way of explaining something; (outcome lesson about teaching –teaching technique) there was multiple She used multiple ways of teaching the same concepts, (description of teaching technique) so she didn't just rely on a definition, she elaborated on it, (description of teaching technique-scaffolding) she showed us visual examples, (description of teaching technique) and as a teacher (identity) it shows me how I should teach as a Science teacher or a Biology teacher (lesson about teaching/awareness of future context)

I had 47 codes from the analysis of the five group interview transcripts. From the 47 codes, I generated four categories of PSTs' experiences of my teaching. The first category was PSTs descriptions of my teaching practices. The second category was PSTs' responses to my teaching practices. The third category was PSTs' descriptions of their identities and the fourth category was PSTs' descriptions of the knowledge they gained. All four categories had subcategories. The categories and sub-categories are all shown in Fig. 4.2 below.

Presentation of Findings

Below I present the findings from the analysis of TIs, my teaching and from PSTs experiences of my teaching.

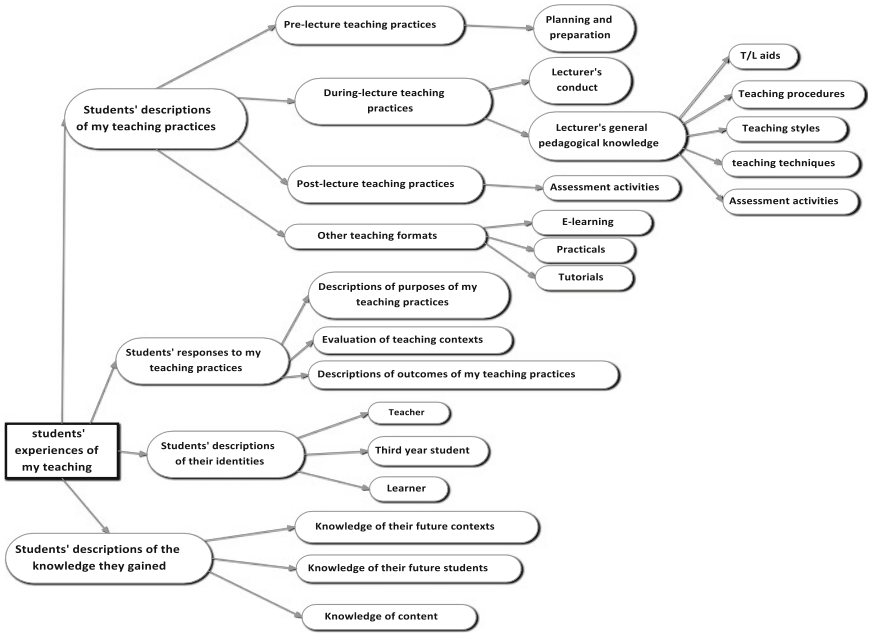

Fig. 4.2 The results from the coding of PSTs' interview transcripts

Findings from the Analysis of Trigger Incidents

California and I identified many aspects of my teaching from the TIs that could be considered cases of modelling good teaching to PSTs. Some of these aspects were easy to identify and others were subtle and not easy to see. The aspects that were easy to identify were the general pedagogical practices such as the use of T/L aids, discussions, explanations and question and answer sessions. The subtle aspects of my teaching were those that I had never thought about when I was planning and when I was teaching. These aspects were: the use of tenets of constructivism, practices that show that I care about students that I teach and that my teaching is student centred. In the illustration of the analysis process earlier on, I described the evidence that indicated that I was applying constructivism in my teaching and that I care for students. The tenets of constructivism showed in the way I had used a visual aid to find out the prior knowledge PSTs had about genetics. An attitude of caring showed in looking for an image to use in my teaching to help PSTs to understand what genetics is about. California pointed out more aspects of caring in the other TIs. For example, in the third trigger incident in which I went to listen to Simba and Kuda and gave them feedback (Simba and Kuda had refused to participate in a whole class feedback session for fear that their fellow PSTs would laugh at them if they

use incorrect English or ridicule them if they happen to give incorrect responses), California pointed out that what I did showed that I cared about students:

> *You are empathetic. The fact that you went to the students despite the structure of the lecture theatre and listened to them and were able to understand their position is empathy. I again see student centeredness. Most of the times we think of student centredness in terms of getting students to be actively involved but there are other levels of student centredness … caring for students is one of them.*

In TI two, Regina and Dylan were not participating in a discussion. Therefore, I went up to them to investigate why. California pointed out that going to the students to investigate why they were not participating in the discussions, was student centredness and student centredness is an aspect of caring:

> *You were able to discover these things because you reached out to students. You wouldn't have known these things if you had not reached out to them. You do not see your position in front of the lecture room as your fixed position. You go to your students to find out, to try to know individual students at a much deeper level. This is student centredness.*

As we were going through all the TIs, we noted that the aspect of caring was featuring in all seven TIs. During the analysis of interview transcripts we noted that PSTs had also picked this aspect of caring in the way I had taught them. The utterance by Tendai shows that PSTs experienced the caring aspect that my CF had picked in the TIs:

> Tendai: *I personally really enjoyed the fact that she was always prepared. It makes a big difference, and that she put so much effort into making us understand, because she didn't have to get flowers and she didn't have to do any of those things because, I mean, she's a lecturer, and she said that this is the textbook, do it, that she could have quite easily have done that. But the fact that she always tried to get us to learn and that she was showing us more than just learning genetics…. I think that was very helpful*

The other teaching practice that my CF picked from one of the TIs was the tendency to tell students answers when they ask questions instead of prompting them so that they can get to the correct answers themselves. In TI number 4, I rushed to give an answer to Fadzi's question and later as I was reviewing the teaching with California realized that by rushing to answer the question, I had missed an opportunity to understand better the source of the difficulty the PST was facing and in the process gave an answer which, though correct was not addressing the PST's problem.

In addition to identifying teaching practices, recording the TIs and reflecting on them also helped me to understand my teaching. I became aware that the use of representations such as models, analogies and examples are tenets of constructivism which according to Cimer (2007), facilitate the development of a better understanding of abstract concepts. Furthermore, the TIs helped to clear some assumptions that I had about PSTs. For example, when Regina and Dylan did not participate in the discussions, my first thought was that they wanted to undermine my authority, only to find out that Dylan was trying to understand the content in a way that would work for him which was to go over the explanation in silence instead of discussing it with someone else. When Walter walked out of the lecture theatre during a presentation

by a guest lecturer, my thinking was that he was being inconsiderate and rude only to find out that he had been emotionally affected by what was being presented. Reflecting on these TIs therefore helped me to develop a better understanding of how to best respond to PSTs' behavior during teaching sessions.

Findings from the Analysis of My Teaching

In this section, I present aspects of modelling teaching to PSTs that showed in the videotapes of my teaching. My main focus was to find out if I had modelled teaching to PSTs that covered the four domains of a teacher's knowledge namely knowledge of context, knowledge of students, PK and knowledge of content. I present my findings in Table 4.3 below using the four domains of knowledge as sub-headings.

Table 4.3 Findings from the analysis of my teaching

Knowledge of context	Knowledge of students	Pedagogical knowledge (PK)	Knowledge of content
Knowledge of my context- the diversity in my classrooms-- e.g. knowledge of students' different linguistic abilities and schooling backgrounds	**Knowledge of misunderstandings that students bring to class** e.g. that interphase is part of meiosis	Use of a variety of **T/L aids** (pictures on the screen, charts, models, concrete materials)	**Specialised content knowledge**-- e.g. highlighting aspects of genetics content that makes it difficult to teach and learn
Knowledge of my students' context- e.g. description of T/L aids appropriate for use in rural contexts and for urban contexts	**Knowledge of misconceptions that students bring to class** e.g. that genes are directly responsible for our features	**Teaching styles** (visual/ auditory/active/passive etc.	**Common content knowledge**-- e.g. description of the structure of DNA
	Knowledge of genetics concepts that students find difficult to learn about	**Teaching activities** e.g. explaining and describing	
		Individual work e.g. draw, quiz	
		Formative assessment activities e.g. quiz	
		Teaching and learning activities e.g. **whole class discussion**, worked examples	
		Role-playing student to student interaction through small group discussions or discussions in pairs	

The results presented in Table 4.3 above show that I managed to expose PSTs to knowledge of the four domains of a teacher's knowledge in my teaching of genetics.

Findings from the Analysis of PSTs Experiences of My Teaching

PSTs' experiences of my teaching fell into four categories that I could identify from the analysis: PSTs descriptions of my teaching practices, PSTs' responses to my teaching practices, PSTs descriptions of their identities and PSTs descriptions of the knowledge they gained. Examples from these categories are presented below. It was however difficult to present each category separately from other categories as they were all inextricably intertwined within students' utterances. I therefore used an integrated approach in my presentation whereby as I presented examples of PSTs' descriptions of my teaching practices, I at the same time was highlighting aspects from the other three categories.

The PSTs' descriptions of my teaching practices included pre-lecture pedagogical practices such as planning, good organization and punctuality, during-lecture practices such as the use of T/L aids and post-lecture practices such as being available for consultation and assessment activities. Munya for example mentioned planning as one of the good teaching practices that he had observed from my teaching and went on to point out what he had learnt from that practice as a future teacher:

> Munya: *I think also the key aspect that she displayed was planning. I learned that if you're going to teach learners, and make sure that they understand, you first as a teacher must first be prepared – fully prepared – and organise each and every thing that you are going to use, so that when you implement whatever plan you had, you have, you cannot be confused and will be able to clarify any misconception and challenges that you're going to encounter.*

Munya's utterance showed that first; he was looking at himself as a future teacher (identity) and second was able to focus beyond the content that I was teaching them to the pedagogical practices that I was modelling. As a result, he was able to derive meaningful lessons about teaching from my teaching. Munya went further to describe the motivation to attend lectures and the enjoyment of the genetics course that he experienced as a result of coming to know that my teaching was thoroughly planned.

> *… there's nothing that motivates me more to go to a class where you know that you're going to do something constructive. So basically, as I have mentioned that she was always prepared, that motivated me to keep on going to class each and every day, so it helped me to enjoy and love the genetics course as a whole. And also based on the practicals, like in genetics, I never thought of any practicals that are possible to be carried out within the context of genetics, so to me it was challenging to see the new strategies she came up with to try and outline the concepts within meiosis.*

The during-lecture teaching practices that PSTs described include the use of T/L aids, teaching techniques, teaching procedures and teaching styles. PSTs made reference many times to my use of T/L aids. The T/L aids included visuals like charts, diagrams on the chalk board, models and real objects like flowers and string. The PSTs did not only mention the T/L aids, they also made comments on what they thought were the purposes of using the T/L aids. Agnes for examples saw provision of concrete examples as the purpose of my use of the T/L aids.

> Agnes: … *she always had either the posters or something to refer to or hands-on materials like the strings and so forth, always just to give us concrete examples or something that we could see.*

Plackie saw my use of visual aids as bringing life to the abstract concepts and judged the use of visuals as 'good teaching strategies'.

> Placki: *Ja, when she was explaining the chromatin network and how it shortens and thickens with the different ropes like a good visual, like you could actually see it happening and picture it in yourself. And then also getting us to view the slides and identify what cells were going under what. Those were good teaching strategies and tools.*

The words 'good visual' and 'good teaching strategies and tools' show that Plackie did not only learn about the chromatin network but also examined how I had taught it and concluded that it was good. Therefore, the use of visual aids not only promoted her learning of content but also developed in her an understanding of the usefulness of T/L aids in teaching. Percy showed that he had gained pedagogical knowledge for teaching genetics from the way I had taught the course:

> Percy: *Look, I have to admit, before this course if I had to teach genetics, it would have probably been diagrams on the board, a couple of worksheets, chalk-and-talk, I might have shown them a video or two, but I wouldn't have really had that tangible aspect. From the course itself in terms of the practical activities and even from the group works and presentations I have learned techniques which I am going to use as well, and you know that's something that I think is very valuable … and for the course to then have permitted that, was good in itself.*

Percy's utterance above shows that just like Munya, he also took on the identity of a future teacher and as a result was able to learn from the pedagogical activities that they were doing in the course. Agnes showed that she disliked one practical activity that they did that was called the Reebop activity. For her, the activity was not suitable for a third year student (identity):

> Agnes: *Okay some of the activities, you'd do it and you'd be like,* "*okay, we could have just left that little part out*", *like with the Reebops, with the building of the marshmallows and everything, that for me was just a little bit maybe not for the level of the third year student. It was a good activity, just the concept, but just maybe don't take it as far as having to build the little creature.*

Percy on the other hand liked the activity.

> Percy: *Looking at the practical aspects especially the practical with the Reebop, it gives a different dimension to what can be done in terms of Biology. It makes it more fun and entertaining for if you're looking at kids – Grade Nine, Grade Ten, it sort of almost personalises*

the content to a certain extent where they can actually interact with what's happening and with Biology it's not always the easiest things because you can't give them a live animal and watch this thing mate to a certain extent, so it's a good representation, it brings the knowledge onto the learners' level.

The utterances by both Agnes and Percy showed that PSTs were taking on different identities during the course and these identities they were taking on at any given time influenced the learning they were getting from the activities they were doing.

PSTs descriptions of my teaching practices also showed that they not only gained knowledge about the different kinds of T/L aids but also knowledge about the T/L aids that they can possibly use in their future contexts which maybe poorly resourced schools.

Chipo: *I think another thing is we as teachers we are going to teach at schools which are not equipped with the resources, the resources she used, any teacher can use, anywhere. So I think it kind of teaches us to kind of use different variety of resources. For example, she used pictures, a normal picture. Any teacher can get a picture of the different varieties of cow skin. Another thing she used was the flowers, the roses, she brought red roses, yellow roses, white roses, to show us the different variations of roses, colour in roses.*

The utterance by Chipo above shows that she gained knowledge of the kind of T/L aids she can use when teaching certain genetics concepts in poorly resourced contexts. We see here evidence that the use of T/L aids was not only useful in terms of helping students to understand content but was of personal relevance to students as future teachers. Agnes gained knowledge about possible future students in the course. She felt that the course had prepared her to handle children with albinism and showed that she was aware that this is something she may encounter in her future contexts.

Agnes: *As a teacher like for example, with the albinism, we were made aware of if we have a student like that in our classroom, let them sit a little bit more in front, try and keep it a spot in the classroom where's there's not much light or whatever that's going to distract the learner or whatever and their ability to see, so as a teacher it made me it will prepare me for maybe students that may have some of the genetic mutations and so forth. So it will help me to understand my learners a bit better.*

In terms of content, because genetics is a content course and the main aim of the course is to teach students about genetics, it was expected that PSTs would gain content knowledge. However, not all PSTs experienced the content that I taught in similar ways. Margie encountered new content which she had not encountered in high school.

Margie: *I'd say the crossing part of monohybrid and dihybrid… all of that. In high school my teacher never did that, so it was new to me…She never explained anything so, ja. That's what I learned as something completely new.*

Tendai gained a new understanding of the content she had learnt in high school.

Tendai: *Well we did the structure of DNA and chromosomes, and it was actually the first time that I really understood chromosomes, I realised at school I never understood them* [*laughs*].

Ephy encountered content that was likely to confuse them as future teachers.

> Ephy: *I think what I came to understand is she focussed on stuff that we would get confused, so we as future teachers know how to, if we are faced with the same confusion, we know how to engage with that information and put it to our learners in a simpler way. So she's creating understanding, making sure we understand whatever concept that she's teaching well, so when we go back to the classroom, we can teach that concept well.*

Therefore, some PSTs gained new content. Others gained a new understanding of the content that they had done in high school. Others, experienced depth to the content that they had learnt and content that prepared them to deal with confusing genetics concepts in their future teaching of genetics. The content was taught in completely new ways that helped them to understand it better. The PSTs also gained knowledge about misconceptions associated with the content they were learning and content that was useful and sufficient enough to make them feel comfortable and confident when they thought about teaching the same content in future.

Discussion

In the self-study that is reported in this chapter, I investigated the effectiveness of modelling teaching in PSTs in an attempt to address the dual responsibility of a teacher educator; teaching PSTs for understanding of content and for teaching that content. The findings from this study show that I used a number of teaching practices in my teaching as part of modelling teaching practices to PSTs. The findings also show that PSTs learnt content and ways and skills of teaching that content from the way I taught the course. The teaching practices that I used in my teaching include the use of a variety of T/L aids (such as models, charts and pictures), teaching techniques (such as questioning and the use of analogies) and discussions and feedback sessions. I deliberately used these practices as part of modelling good teaching to PSTs. The other aspects of my teaching which I identified with the help of a CF were tenets of constructivism and caring for students. I did not plan these aspects of my teaching. They played out as a result of the modelling of good teaching that I had undertaken.

The analysis of interview transcripts helped me to identify the learning PSTs had gained from my teaching. PSTs gained more than content knowledge from the genetics course. They gained some knowledge of their future contexts and their future students as well as PK. Knowledge of content, one's context, students and PK is knowledge that a teacher should have for effective teaching to occur (Rollnick et al., 2008). PSTs gained pedagogical knowledge through observing and participating in the activities that were done in the genetics course. This way of learning about teaching shows that modelling teaching when teaching content courses can be an effective way of teaching PSTs content and how to teach that content. Modelling teaching in content courses can support and develop the pedagogical knowledge that PSTs need for their future teaching of that content. According to Maduna (2002),

many teacher-training institutions are failing to provide training to PSTs on how to select and use T/L aids in one's teaching. The use of T/L aids in my teaching as a way of modelling good teaching showed that it indirectly provided that training.

In this study, PSTs took on different identities during the course. They sometimes viewed themselves as learners, sometimes as third or fourth year students and sometimes as future teachers. The identities that some PSTs took on during the teaching and learning activities caused them to view the teaching and practical activities as inappropriate. The ability to recognize multiple identities enabled other PSTs to overcome similar problems. The case of Agnes showed that not all PSTs were able to see the teaching intentions behind the teaching activities that I engaged them in during my teaching of the course. This observation brings out the need for us as teacher educators to practice the form of modelling that was described by Loughran (2006) whereby in addition to demonstrating good teaching practices, PSTs are also offered access to the pedagogical reasoning underlying a particular teaching approach if they are to benefit from our teaching practices as future teachers. There is also a need for us as teacher educators to constantly remind PSTs to take on all three identities of learner, university student and future teacher in our teaching of content courses if our modelling of teaching is to achieve the twofold agenda of teacher education of enabling them to learn content as well as the skills and competencies of teaching that content.

The various aspects about content that students talked about reflect the diversity in academic background that was characteristic of my genetics class which was necessary to consider when I was choosing content for my course. I needed to consider that some PSTs' had not done biology in high school and others had not done the topic of genetics. Other considerations were in terms of PSTs' future teaching contexts. I am therefore of the idea that the choosing of content for a course should be a collective endeavour where all members of a subject in the faculty get involved. Inputs from colleagues based on their own knowledge of contexts, knowledge of students and knowledge of content is likely to build a course that will cover most of the aspects about content that PSTs made reference to during interviews.

Discussing the TIs with a friend helped me to not only confront some wrong assumptions that I had about students, for example, the cases of Regina and Dylan and of Walter but to also understand the salient aspects of my teaching. Before discussing the TIs with my CF, I was completely oblivious of the fact that my behavior in the seven TIs reflected an attitude of caring which California picked up and PSTs made reference to in their interviews. It took a CF's input for me to become aware that by doing what was described in the TIs, I was actually sending a message to students that I care about them. This finding confirms an assertion by Loughran (2006, p. 77) which says: *A shared experience with a valued other provides greater opportunity to reframe situations and confront one's assumptions about practice*. As the course progressed, I was now deliberately enacting those pedagogical practices that show that I care as part of modelling good teaching practices. Discussing the TIs with a CF also helped me to understand the importance of what Mason (2002) called noticing. To notice is to perceive or to become aware of a change in one's environment or situation (which in my case was a teaching situation) that is captured by one's sensitivities which may be emotional, physical or cognitive.

Noticing helps a teacher or teacher educator to recognize and to build on that which is problematic in practice. The ability to notice helped me to act on what I was noticing by checking with the students. In the process I got to learn that there was more to students' behavior than what I had assumed. Therefore, by checking what I was noticing or by taking some action and/or reflecting, I increased the range of meanings of what I was noticing. According to Mason (2002), a range of meanings of what one notices helps one to make informed decisions on how to act in a moment or to respond to situations as they emerge. Acting on what I was noticing also helped me to develop a better understanding of what was happening in my teaching which in turn helped me to think of teaching and assessment strategies that were suitable for my classroom context. Therefore, noticing is an important attribute that we need to develop as teacher educators as being able to notice and to act on teaching situations is a source of valuable information that can promote modelling of good teaching practices. However, noticing requires a sensitization which only develops with experience (Mason, 2002).

Conclusion and Implications

The aim of this self-study was to find out how to teach genetics in a way that helps PSTs to learn content as well as how to teach that content. This study has shown that it is possible to teach content for understanding and for teaching to PSTs and modelling good teaching is one approach that has the potential to successfully achieve this twofold agenda of teacher education. The study confirmed the assertion by Russell (1997) that how we teach is the message that students get from our teaching. The study also confirmed the suggestion by Loughran (2006) that we can teach preservice teachers about teaching by modelling teaching practices. Although Loughran made this suggestion in the context of teaching methodology courses, this study has shown that the same can be achieved in the teaching of content courses. In conclusion therefore, I argue that as teacher educators we can teach a content course for understanding and for teaching by modelling good teaching practices.

Reflections

After the analysis of my teaching and students' interviews, I presented my findings to Nico for critical feedback and validation of my findings. Below I present the comments that I got from Nico which became a catalyst for reflection. I also present my reflections on this self-study.

Comments from Nico on my teaching: *What you did is not your "normal' teaching, but something that came with a lot of effort on your part; some kind of rehearsal, you may want to say. Yes, I know, in the process you developed yourself into a good teacher. But is this sustainable; or it is just for display? Would someone not do nearly the same with the same effort?*

Comments from Nico on what PSTs said in the interviews: *Why are there no tensions and contradictions in your teaching to make the whole thing credible*? *You would need to analyse your quotations in detail to bring about the hidden meaning behind all those nice words students say about your teaching*.

There are two issues that Nico's comments bring out that are important for our practice as teacher educators. The first one is that good teaching certainly does not come easy. It requires time. As a result and as Nico said, the effort that I put into my teaching in this study may be difficult to sustain. However, what I think would be important to focus on is the evidence of classroom practice that I gathered that has equipped me with the knowledge and expertise that I can use to continuously improve my own teaching of content courses and that of others to PSTs. Therefore, while it will be difficult to sustain the effort that I put in my teaching in this study, the initiatives for continuous improvement of practice and professional development are sustainable. The second issue that Nico's critique brings out has to do with some common difficult associated with self-study research; that of academics seeing self-study research as self-indulgence. Collaboration with colleagues and literature which is a characteristic of self-study can therefore not be over-emphasized when doing self-study research. Nico's acknowledgement that in the process of doing this self-study, I developed into a good teacher also shows that there is value in self-study; that of enhancement of teaching.

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