Student Stories about Mathematics: A tool to understand more about the teaching and learning of mathematics.

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Contents

Abstract

This qualitative study sets out to explore the experiences of secondary school students while they are learning mathematics in school. By using student stories of learning mathematics as my main data collection method I began to understand the view of mathematics that my students were constructing as they negotiated the complicated terrain that I know as the mathematics classroom. This method of student stories to communicate student voice was selected by me to allow the students the freedom to express themselves in a variety of comfortable, differentiated formats.

My methodological approach evolved as the action research phases progressed, allowing for methodological inventiveness (Dadds and Hart 2001). This was a deliberate decision by me so that my research progress could be best served by a suitable methodological approach. The end result was a qualitative study that embraced a living theory model of action research (McNiff 2013), where practitioners can develop their own personal theories of practice (Whitehead 1999). Within this action research structure I used a narrative approach, considering narratives both as a data collection method and as a transformative phenomenon. Using the ideas of narrative research for data collection, I facilitated storytelling workshops with my students, collecting stories to inform the research interest. In this research, using narratives was also considered as a phenomenon because of their influence in allowing authors to model and re-model their experiences through their stories. I found that considering narrative as phenomenon complemented and supported a portraiture methodological stance (Lawrence-Lightfoot 2005). Narrative as a phenomenon also became apparent by the influence the student stories had on my

ability to understand my classroom and my subsequent teaching practice. To analyse the story data I utilised the ideas of Anderson (2011) who developed a transpersonal research method that incorporates the researcher's intuition, emotional and personal capacities into the research process. By using a multi-method approach of thematic analysis, symbolic interactionist perspective, input from colleagues and my reflexive intuition, I formed an analysis of the data that could be used to look at similarities and trends in the student stories. In addition, working with the student stories encouraged levels of empathy between the reader and the student author that transformed classroom practice and understandings. There are several ways that this thesis can contribute to practice. Firstly this research develops a pedagogical tool that encourages student voice, celebrates individuality and helps create an approachable interface between mathematics teacher and student. Secondly, it models how this way of working could be used to inform the practice of the classroom teacher by developing a deeper understanding of their students. Thirdly, the identification of particular themes is invaluable to subject department development and planning, and these themes can feed into a department and whole school ethos. Finally, it models a form of action research that encourages critical reflexive practice and utilises the knowledge, experience and intuition of the researcher with the sole purpose of improving the experiences of their students.

Chapter 1: Introduction

This chapter introduces the context of my research, describing from my perspective the climate with regards to being a school mathematics teacher. I describe the origin of the main questions that form the foundations of my research inquiry and what I had hoped to achieve by carrying out this particular research. I explain the reasoning behind the choices that I have made regarding the style of research and the nature of the data collected. I have included, at the start of this introduction an original diary extract written during the early stages of my research development. Other diary extracts are threaded throughout the research write up to communicate to the reader my own personal story as a teacher of mathematics and researcher, and the influence that the student stories had on my practice. My research design and subsequent structure is built around addressing my main research aims and seeking answers to subsequent research questions.

Aim 1: To explore the views of my students about their experiences learning mathematics.

Aim 2: To develop a pedagogical tool that can be used to learn more about how particular students perceive learning mathematics at school.

Aim 3: To gain a deeper understanding of the less visible influences that are at play when students take part in a mathematics lesson.

These aims and the influences that gave rise to the research idea led me to two initial questions that I felt that I would need to address. The first was in response to my impression that many adults that I met carried negative memories of learning

mathematics in school, and my second was in my quest that this research would contribute to improving my practice.

Question 1: Is learning mathematics at school an uncomfortable memory for a number of my students and if so, what are the causes?

Question 2: Can mathematics teachers create a more approachable and effective interface between themselves and their students?

As the research developed a number of other working sub-questions arose as a response to the research progress and these provided direction for the development of this action research. These sub-questions were designed to facilitate the production of student data that could inform the two initial research questions. Although there were many questions that arose during the research, the response to these particular working questions determined the next stage of the research process.

1) Would students be willing to share with me, the classroom teacher, their stories about learning mathematics?
2) Would the student stories about learning mathematics contain rich data that could help progress this research?
3) Will a storytelling workshop be successful with students that have experienced a struggle in mathematics?
4) Is the storytelling workshop transferable?
5) Can sharing student stories about leaning mathematics promote a purposeful and positive change in practice for the mathematics classroom teacher?
6) Can experience and intuition provide the foundations for a qualitative data analysis tool?

1.1 My Diary Extract

I have been teaching mathematics since I was seventeen years old. How strange that seems because I hated my own schooling, and as a student, when asked what I was studying at university, I cringed when I disclosed my subjects. But, that is my baggage, something that I will need to unpick as I write this story. I love teaching mathematics, it is interesting, every experience is different and I get the chance to tackle puzzles each day. In the same breath, I am exhausted teaching mathematics, people seem to have so many barriers to learning the subject, I want to ask them to trust me, to relax, to allow time and let the learning happen, but it is not as simple as that. The expectations from my institution are different, schools in general treat learning maths as a linear function, with cause and effect. Teachers impart the knowledge, and in a reciprocal relationship, the students gain that knowledge. So logically, when that is not happening then there must be straightforward reasons such as, the teaching is poor, or the student has learning difficulties.

So when I experience adults telling me that they could never do mathematics at school, or that learning mathematics was one of their worst experiences at school, I can console them with one of the two most obvious facts, either you are limited mathematically or your mathematics teacher was not a good teacher.

How ridiculous to suggest that things can be so simple, there has to be something else that creates this phenomenon. I have worked with many students that are clearly very intelligent but are not content with their achievements in school mathematics, and I have worked with mathematics teachers who are fantastic and inspire their students, yet there are others, clearly good at mathematics but who cannot deal with the challenges that their pupils present them.

What challenges you might ask? Everywhere I go there are examples of perfectly intelligent people displaying examples of personal phobia in relation to mathematics, their mathematics teacher, mathematics lessons or their mathematics exam grades. I have a personal and professional need to root through, and understand this mathematical baggage.

1.2 My Concerns

Throughout my career as a mathematician, and particularly as a teacher of mathematics in London schools I have pondered on two main issues. One is the response from the public when informed of my Job, and the other is the initial interactions that occur in the first weeks of getting to know a new mathematics class.

The first of my issues affected me mostly in social situations when my companions found out that I was a mathematics teacher. The declaration of my Job would elicit stories about their experiences learning mathematics, and sometimes they would move on to the experience of their children. I found the stories uncomfortable because they often portrayed mathematics teachers as unkind and unapproachable. In many cases, the stories were laced with strong negative personal emotion and I felt that it was my duty to provide counsel. They often portrayed mathematics as a foreign medium that was inflicted on everybody but that only an elite few could access. This reaction to my choice of career made me reluctant to disclose my profession when I was not in an academic setting, and this overwhelming feeling to hide my talents and love of mathematics was the driver for a burning question that laid the foundation for this research. I wanted to know whether learning mathematics was an uncomfortable memory for many people, and if it was, then I wanted to explore and understand why?

The second issue evolved from two areas, the first was my own professional practice as a mathematics teacher and my experiences during the introduction period involved when getting to know a new mathematics class. The second area was

influenced by my role as director of learning for mathematics, witnessing on numerous occasions, groups of students bringing new mathematics teachers to their knees, taking no prisoners. It was as though they had made up their mind before the lesson had started that this teacher did not speak their language and was not worth engaging with. If they lasted the course, in time, this teacher became accepted, but for many students and mathematics teachers, this display of alienating behaviour left a lasting impression. This led to my second research area which was to explore whether mathematics teachers could create a more approachable and effective interface between themselves and their students?

These two research areas led me to a specific aim for this research and this was: To understand more about what our school students experienced when learning mathematics at school, and how this process shaped their mathematics story, a story that they could potentially carry with them into adulthood. However, as my research progressed, I began to explore how the student stories about learning mathematics in school could enhance the relationship between mathematics teacher and student, and this became a powerful element of the research.

1.3 The Context

My research was set in an 11 to 18 comprehensive school that is based in the centre of London, close to excellent travel networks and a range of other 11 to 18 schools. The excellent access to travel links meant that teachers and students could travel to this location from considerable distances. This school historically recruited students from over 40 different primary schools which meant that the students often arrived for their first day at school not knowing anybody else at the school. The teachers at

the researched school worked with local primary schools to familiarise themselves with the students and the teaching adopted by these schools, but the reality is that in one year group this pre-school preparation would benefit only a handful of students. For many students starting at the researched school, their first experience of 11 – 18 education was as a stranger with no familiar faces to help them feel at ease in a new, potentially stressful, environment.

The Department for Education published performance tables for secondary schools across the UK (DfE, 2011). This was seen by many people as an indicator of how successful a school was at educating the children in its care. Schools were ranked, at the time of the research, by the percentage of students gaining at least 5 A* to C including the key subjects of english and mathematics. Subsequently, in schools such as the researched school, these league tables drove a rigid performance management structure which held departments and their subsequent teaching staff directly responsible for the performance and attainment of students taking that particular subject. As a key subject, the mathematics department was under considerable pressure to produce, through the attainment of its students, high GCSE grades and this pressure was often communicated directly to the students studying for their GCSE's. The close proximity of four other 11 to 18 schools meant that students and parents that were considering the researched school could also consider seriously four other 11 -18 schools. This fact created a strong competitive culture between the schools and heightened the importance of exam results and league tables in attracting students to the researched school.

The children researched in this report experienced their mathematics education through the influences of the Department for Education national strategies for mathematics (DfE, 2011). A key focus of the key stage 3 and 4 national strategies was assessing pupil progress at regular intervals using APP guidelines (DCSF 2009). Pupil attainment was measured using national curriculum levels (DFEE 1999), targets were set for pupil progress, pupil progress was tracked through, and across, each academic year group and reported at regular intervals.

The mathematics strand of the Key Stage 3 National Strategy built on the achievements and experience of the National Numeracy Strategy for primary schools. As well as seeking to improve transition from primary to secondary school it was also a key part of the strategy to transform standards in the early years of secondary school.

> We have already seen from primary colleagues that targets are important to challenge, motivate and raise expectations. It is important that we carry this forward into the early years of secondary education. We recently consulted on targets for 14-year-olds, and we believe that they will help schools in providing a clear focus for the first year of the new strategy (Blunkett, 2001).

In the researched school, this focus on target setting and reporting became a particularly prescribed process for the key subjects, english and mathematics. The students were assessed regularly, the results of each assessment were discussed with the student in question, usually by the subject teacher, and targets were set for the next assessment. Throughout their secondary school years (age 11 to 16), the students were well informed about what level of mathematics was accepted as the average for a particular age, what level would indicate that you were ‘good at

mathematics', and where they ranked in the whole process. This rigorous approach to assessment created a natural tendency towards valuing correct answers and high marks in assessment. It raised a heightened awareness of ranking, associating performance in assessments directly with ability, and generally created a pressurised environment within which the students were expected to function. The prescribed periods of time between assessments made no allowances for students that may need more time, perhaps needed to absorb a particular mathematical concept or just because the students had things happening outside of the school that was interfering with their capacity for learning.

I set out to explore the ways in which children make meaning about learning mathematics in response to their daily interactions and past experiences, and planned to achieve this by drawing on the experiences of children in my own class room, and then disseminating successful methodological tools and approaches in the classrooms of other mathematics teachers. In reality, this research that was initially designed as a response to gain knowledge that could address my research questions also became a pathway to self-inquiry, and scrutiny of my own professional practice.

I chose to confine my research to what I felt was my area of expertise, which was secondary school mathematics teaching. During this research my professional role was as the director of learning for Mathematics in an 11 – 18 London girl's school. I was accountable for the progress of students in mathematics and my responsibilities included staff development, overseeing the delivery of mathematics curriculum, and

raising standards in mathematics. During my work as a teacher and leader in mathematics, I made it my duty to actively seek answers to questions such as how can I improve the quality of the educational provision for children learning mathematics and how can I ensure that the children's experience of learning mathematics is a positive and emancipatory one?

My research was framed to take particular account of the social world of learning mathematics. This decision was based on tacit knowledge accumulated over many years, knowledge gathered from hearing adult stories, reflecting on my practice and observing other mathematics teachers in their classrooms. The objective of describing mathematics as 'social' in this research allowed the inclusion of understanding classroom behaviours and the different meanings that students bring to their encounters with school mathematics. In researching the social world of learning mathematics, I wanted to explore and gain an understanding, from the student point of view, the subjective meanings expressed by students when interacting with mathematics in their everyday school life. In doing this I hoped to move towards an understanding about why some students cope well with formal mathematics practices and some students struggle (Baker and Street, 2000).

1.4 The Research

My research approach incorporated an interpretive stance combined with aspects of critical inquiry. This approach allowed me to examine my values and beliefs, and consider the part they played in the research design, process and outcome. The critical approach took into account the political and ideological contexts of the research, which in my case, could be described as 'the emancipation of individuals

and groups in an egalitarian society' (Cohen et al, 2003:28). In this approach I was particularly interested in inequalities that exist because of the nature and place of mathematics in our society, and I hold the view that in this research seeking out and highlighting these inequalities could influence institution leaders.

The methodology that underpinned this research was complex and drew on various disciplines. The choice and development of methodology was driven by my aims, values, social purpose and personal beliefs about learning and the creation of knowledge. My interest in the stories of people learning mathematics defined this research for me as a qualitative study, and my desire and need to incorporate the work with my practice and values fundamentally dictated an action research design. This design supported my aim that any research I undertook should improve practice by supporting the ever continuous place of researcher reflection with an intention of making the classroom an improved learning environment.

I began to understand as the research progressed that research that matters to me would not be impartial, hence a substantial influence on the research was my role in the design, progress and outcomes. The analogy of doors is one that relates well with my action research design and the potential bias that I bring to the work. To see the doorway is to notice an opening, and to investigate what is behind the door can lead you to new paths with new doors to look behind. However, some of these doors will lead to a dead end and you may have to retrace your steps, and some doors will lead you along corridors that take you back to the same initial starting point, as can the paths in the action research process. There are doors that only open at certain

times, some I peek through, nervous about what is behind them, others I stride through with the confidence that this is the right thing to do, and yet there are others I let shut immediately without even considering the treasures that might lie behind them. During this research I found it important to consider the reason that I let some doors shut quickly, and this reflexive process informed the methodology and the research process, incorporating the researcher and the research reflexivity as pertinent data. I found that this research opened doorways into self-reflexivity, scrutiny of practice and relationships between researcher and those researched.

Reflexivity is a key concept underpinning the whole structure and development of this research and can be understood in a multitude of ways according to the aims and functions of the exercise at stake and the theoretical or methodological traditions embraced.

> Reflexivity, or a turning back onto a self, is a way in which circularity and self- reference appear in inquiry, as we contextually recognise the various mutual relationships in which our knowing activities are embedded (Steier, 1995:163).

Krippendorff (1991:5) highlighted a subtle difference between being reflective 'in showing ourselves to ourselves', and reflexive 'being conscious of ourselves as we see ourselves'. He explained that reflexivity could be understood as a bending back on itself, a circular process, where the circularity is liberating, allowing the self to be fluid and developing alongside the research process. The reflexive process informed my methodology and the research process, with the researcher included in the research and the research reflexivity included as pertinent data. There are a number of possible motives for including self-reflexive accounts as explicit sections in a

research paper. In some cases this manifests as a simple identifying of oneself and in other works researchers indulge in narratives of the self, and this process becomes the body of the research. Bruner (1986:150) explained that the researcher 'appears not as an individual creative scholar, a knowing subject who discovers, but more as a material body through whom a narrative structure unfolds'. However Finlay (2002) pointed out that excessive self-analysis at the expense of attending to the research participants can be problematic.

> Being preoccupied by one's own emotions and experiences, however, can skew findings in undesirable directions. The researcher's position can become unduly privileged, blocking out the participant's voice. Clearly, we need to strike a balance, striving for enhanced self-awareness but eschewing navel gazing (Finlay, 2002: 541).

Another motive for self-reflexivity may be to give the research assumptions and findings credibility. However, the danger now becomes one of power and the use of reflexivity as a tool to reinforce rather than question the author's voice. Reflexivity as recognition of other is a characteristic of qualitative research. The aim of this reflexive practice is to give the researched a voice, 'let them speak for themselves' (Pillow, 2003:181), and one strategy for this can be to make evident how the researched has participated in the making of his or her own image, and how power is shared by researcher and researched. The researchers' agenda will always create an imbalance of power due to the fact that the researcher has a purpose, something that they seek. The stakes for researcher and researched are not equal and hence neither is any power relationship. Some researchers use reflexivity to discuss how their position as an insider researcher interacts with the research subjects and data, influencing the production of knowledge. Rosaldo (2004) argued that reflexivity itself cannot generate knowledge but, can reflect what has been opened by experience.

Knowledge can only be generated from a shift in position and once we are repositioned reflexivity can inform us as to why, and how, we now know more, and understand better. It is possible to seek to increase the credibility of research work by engaging in reflexive processes. This raises questions surrounding the 'politics of the gaze' (Finlay, 2002), who asked questions such as: Who benefits from our representations? Are our representations valid? Do they matter? Who can we research and when?

Reflexivity as truth supports the idea that the researcher can get it right. It is dependent on discourses of truth, and for me would be more affiliated to a quantitative methodology where we might accept that there is a truth to be found. However, we might read this idea as a quest for the researcher to take precautions to give a truthful account of events, and in this case I would replace the word truth with honest. My position is that I can offer no certainty; no definite interpretation; no answer that will make things better. The best I can pledge is a promise to do my best to represent the research in an honest and ethical manner, with an overall ambition to improve the provision, and by association the experiences, of the researched. Reflexivity as transcendence, for me, is the most important reason that reflexive practice must underpin my research. Reflexivity for this purpose is essential in my action research design, one which holds the optimistic premise that each action research cycle will facilitate understandings that rise and go beyond the previous cycle. The essence of reflexivity for me has two strands: one is about the choice a person makes to examine their thoughts and actions throughout their research. This choice becomes a balance of honesty and sensibility and needs to be underpinned by a commitment to learning, always seeking to understand a thought, a reaction or

an emotion in more depth. For my way of working I see reflexivity as a paradigm shift from a scientific approach, to an interpretive way of working, moving from neutrality to emancipatory values. The second strand of reflexivity I find important to my research is essentially in its potential to facilitate understanding and hence aid the generation of new knowledge (Chambers, 2003). Without a reflexive thread running through my research actions I may miss a layer of understanding that becomes critical to the outcomes and subsequent use of the research. Used correctly, reflexive practice can be a powerful tool to drive a research agenda forward and there are current examples of this process in action (Attard, 2009; Heikkinen et al, 2007; Mc Niff, 2005). These researchers employ a variety of methods based on their epistemological beliefs but each method is grounded by a reflexive process. This underpinning of reflexivity in my research helped me to monitor and critique my actions and choices throughout the research.

Within a practitioner action research structure the main form of data design and collection was underpinned by a commitment to narrative inquiry, and the stories of my students became my main data collection tool. This choice was guided by my assumption that students would be able to communicate their experiences both comfortably and richly through their stories about learning mathematics. I felt that using the medium of storytelling allowed the development of a data collection method that offered less intrusion and pressure than the traditional interview, but could allow space for richer, more spontaneous data than might be collected by a questionnaire or interview.

My storytelling methodology was developed particularly with an aim to give my students a voice that could be communicated in a manner that was comfortable to their individual skill sets. The concept of pupil voice is a development which is often attribued to the ratification of the United Nations Convention on the Rights of the Child (UNCRC) (Lundy 2007). The implementation of the Convention on the Rights of a Child (UNICEF 1989) inspired, in many countries, changes in laws to protect children and policies to ensure that children had opportunities to develop to their full potential. In particular, the section of the UNCRC that relates to the concept of pupil voice is article 12 which;

> provides both for the right of children and young people to express their views on all matters concerning them and to have those views given due weight in accordance with their age and maturity. This right applies to children without discrimination (Lundy et al., 2012 3.5,8).

Subsequently, UK government legislation has influenced the development of research that listens to pupil voice (HMSO 1991, DfES 2004), research that has a focus on the pupil's perception of their school experiences in order to explore and disseminate the pupil's point of view. Compliance with the UNCRC treaty is monitored by the United Nations Committee on the Rights of a Child and this committee publishes periodic reports highlighting breaches to the UNCRC and makes recommendations for future development. It was documented by the committee in 2002 that 'in education schoolchildren are not systematically consulted in matters that affect them and recommended that the UK Government should 'take further steps to promote, facilitate and monitor systematic, meaningful and effective participation of all groups of children in society, including in school, for example,

through school councils' (United Nations Committee on the Rights of a Child 2002: 7). These criticisms were also supported by the findings of a research project conducted on behalf of the Northern Ireland Commissioner for Children and Young People (NICCY) (Kilkelly et al., 2005). It was felt by these studies that many of the adults involved in consulting with young people did not understand the implications of the Convention, particularly its confirmation of the equal status of children as the subject of rights. (United Nations Committee on the Rights of a Child 2003).

My aim for this research was to embrace the culture that pupil perspective is a valuable insight and makes an important contribution to the learning that takes place in school. By this I refer to the learning that takes place both for the student and the adults in authority. At the heart of this respect for informed learning is the notion that students have something to say about school mathematics and what they have to say should drive my decision making. These decisions include a consideration of teacher - pupil relationship, style of learning, curriculum content and issues that can lead to whole school improvements. The importance of engaging students in dialogue and recognising that they are actively constructing knowledge and understanding in these social interactions is a key principle of a social constructivist pedagogy (Pollard 1990). In this view learning entails both personal and social transformation (Packer & Goicoechea 2000)

Ravet (2007) explained that pupil voice research empowers the young people by recognising their entitlement to democratic participation in research that is related to their interests. In addition, Flutter and Ruddock (2004) suggested that pupils could

tell schools a great deal about what is needed for empowerment and that schools could use pupil voice research as a method for evaluation. Listening to pupil voice has been used increasingly in research because it is important to listen to pupils when you want to analyse their needs and understand their perspective. In this research my aim was to utilise a method for my students to tell their mathematical story in a non-intrusive, adaptable and comfortable manner. I used the vehicle of student story to keep a focus on hearing the children's perspective of classroom teaching and the learning of mathematics.

The use of pupil voice to evaluate educational practices has some ethical implications that were important for me to consider when planning and carrying out my research. Macnab et al (2007) explained that school structures can silence the pupil voice because this pupil voice can expose a variety of practices that may be considered as bad practice. The paper by Macnab et al (2007) identified the use of gatekeepers, described as professionals with whom researchers have to negotiate to gain access to a sample. It was suggested that these gatekeepers have professional interests that interfered with their willingness to provide access to certain samples of pupil. In a study reported on by O'Connor et al (2011), there were concerns raised regarding the potential barrier formed as professionals become wary of the researcher and the repercussions of highlighting bad practice. To address this issue an objective of the research described in the report was to work collaboratively with professionals to ensure that they were aware of what was happening at every stage. When conducting research with young people, it was important for me to acknowledge power relations. Numerous suggestions have been put forward within research literature for addressing such power relations; for example, taking the time

to build trust and by providing ongoing opportunities for participants to withdraw from the research (Ravet 2007). Another area of ethical consideration pertinent to my research is that of informed consent. One model often employed when working with young people is the use of another, (parent or guardian), giving the consent and then taking this as implying that the young person has given agreement to participate and that this is an informed agreement. The young person needs to understand what will be involved, what is expected of them and the right to stop participating in the research at any time. Lindsay (2000) pointed out that there are a number of factors to take into account when considering informed consent from young people, in particular - age, cognitive ability, emotional status and knowledge. To address these factors, Lewis (2005) indicated that there is a need for awareness and sensitivity regarding consent and competence so that the young person is in a position to make a considered decision as to whether to take part in the research.

Whilst developing my research I found the basic principles of Portraiture (Lawrence-Lightfoot Davies, 1997), methodologically attractive because it encouraged a responsive and dynamic approach to the research. Lawrence-Lighfoot (1986) described the methodology of portraiture as a source of empowerment for schools, communities and researchers and this approach complemented my aims for the research. The aim for this research genre is to honour and humanise the voices and the experiences of the researched as well as the researcher (Chapman, 2005). Portraitists study the collected data looking for the stories that emerge and then tell these stories with careful attention to voice. In this research I have highlighted my own voice through my writing and the voice of my research participants by the inclusion of their stories. The research account that follows is my self-portrait, it

describes my journey to find a research site and establish a relationship with the research topic. The portrait offers a critical exploration of my development as a researcher and my attempt to position myself as a researcher through the use of voice.

The action research structure of my work evolved naturally into four cycles, three data collection phases, which I have called phase 1, 2 and 3 and then a final fourth phase that was used to draw together ideas and form a data analysis. This structure supported my natural instinct to work with an action research lens. Phase 1 was a pilot stage designed with the specific intention to test storytelling as a data collection tool. Phase 2, again intended to test story- telling as a data collection tool but it differed in two main ways. The first was in the selection of students, using a puposeful selection driven by refined research questions. The second was that it explored how the storytelling data collection worked in the classroom of other mathematics teachers. Phase 3 evolved from questions posed after phase 1 and 2, the group of students selected was a purposive selection, my own practice became part of the data collection, and four students along with their stories became part of a mini case study. The fourth phase was period of time for the compilation and analysis of data. There was no dedicated data collection but I gave myself a period of time for the exploration and development of suitable analysis methods, which included thematic and intuitive inquiry analysis. In this phase, I also focused on my diary extracts which became the foundations of my personal story. It also was a period of time when I could, think deeply about my classroom practice, my observations, intuitions and discussions with parents, teachers and students. It was a development period that allowed me to observe my classroom, tie together ideas

and think deeply about the growth and transformation for myself and some of the students that took part in the research.

My research has altered slightly within each action research phase and the focus has broadened from one of collecting data for personal understanding, to one that also incorporates how that data might improve the provision for teaching school mathematics.

I have chosen to include, throughout the research, a style of writing that I would describe as personal writing. I am aware that this type of writing has certain disadvantages, including an emotional attachment that can lead to the researcher being too close to the research data sometimes resulting in certain points of view being obscured or just simply ignored. My conviction that some personal writing is necessary is supported by my own experiences reading other research scripts, noting the type of writing that catches my attention and resonates with my experiences. Personal writing also helps me satisfy a basic need that I have which is to tell my story, in a very open honest way, supporting my decision to commit to this storytelling methodology. It has been found that writing the personal is a way to begin to locate and critically interrogate our educational experiences, allowing room for a revision of understandings (Schnee, 2009). Schnee (2009) worked towards developing the method of personal writing to bridge and blend the worlds of pedagogy and research. This attempt to find a common understanding between the world of research and teaching was a way for me to address a variety of audiences who may be specifically interested in how school students coped with learning

mathematics. To help balance the personal with a more objective style of writing, I have inserted my personal notes amongst chapters that contain a more detached and debated style of writing.

During my research the model of data analysis I used was varied and adaptive. I investigated the place of content and themed analysis as a way of looking for similarities and contradictions. I explored the opinions of colleagues who also applied a themed analysis to the data set. This process highlighted institutional norms, certain social behaviours, ideas surrounding the participants' view of mathematics and their mathematical identity. Yet throughout this process I had grave doubts about what treasures were lost in the content and themed analysis exercise. After phase 2 I decided that the true value of the student story could be appreciated by keeping the whole story as a single piece of data. By keeping the stories whole, ideas such as fighting for a mathematical identity, struggle with mathematics at school, feelings of inadequacy promoted by actions of peers, teachers or family, stories of hope and future success could be conserved and perhaps re-modelled into a more empowered scenario. The powerful stories convinced me that I needed to look for a different form of data analysis, one that had a place for the way the stories had worked on me. I found my solace in the ideas of intuitive inquiry (Anderson, 2011), and it is through this way of working that the stories started to become powerful mediums by which I could negotiate my understanding of the relationships between teacher and student, student and mathematics. The model of intuitive inquiry proposed by Anderson (2011) correlated closely with the way that I had instinctively started to work with my stories, it offered me a structured yet flexible approach that recognised and utilised my extensive experience of teaching school

mathematics. I adapted the main techniques of Anderson's model to suit the research methodology that underpinned my work and the type of data collected for this research. The multiple way of working with the data highlighted my insider/ outsider positioning, my 'diary extracts and field notes' creating subjective data shortly after reading the student story data, and my analysis of the stories away from the classroom giving me the opportunity to analyse the data as a pseudo outsider research.

There is a variety of literature that has influenced my thinking, one of my earliest influences was the work of Dweck (2000) who explored how we can motivate our learners by paying attention to the type of mindset they have adopted. She claimed that what they have already decided about their brain capabilities, whether knowledge is fixed or could develop and grow, influenced how they tackled learning a subject such as mathematics, and she proposed that this mindset could be altered over time. Another author that has inspired me to investigate the influence of belief and perception was Gladwell (2000), who gave several examples of how influential a belief can be and how small actions can make remarkable transformations.

There is a great deal of literature dedicated to teaching and learning mathematics. A partcular influence that has urged me to develop my critical voice has been the work of Ernest (2001), who argued that if mathematics is inseperable from human contexts then the social implications for mathematics education have to be considered. Personally, I have questioned the role that power plays in mathematics, particularly the power that is used to decide, by using mathematics results, who can

enter certain fields of study and professions. Gates (2004:72) suggests that 'maths education has played its part in keeping the powerless in their place and the strong in positions of power'. Boaler (2009, 1999) explores the impact that differing mathematical experiences can have on how children learn and how they perceive mathematics. For Boaler, the onus is on the teaching profession to deliver mathematics that is varied and related to the world outside of the classroom.

Throughout the research a question that I had hoped to provide some insight into is one that was stimulated by my experience of adult stories, and was posed by Fiona Walls (2009), who asked what is it about people's experiences of mathematics that brings about such a strong sense of alienation? My research participants in phase 1 worked in groups and produced eight stories, these included drawings, cartoons, written stories and a drama. The stories produced in this phase were emotive and evocative and provided some interesting suggestions to address this question. For some it became a vehicle for them to release some pent up anger and frustration. This chance to share emotions and let go of past anger became beneficial to the confidence of the class, and the promotion of a respectful relationship between class and teacher. This was something that I had not considered before conducting the phase 1 stage of the research and, stimulated by the outcome of the pilot phase, in latter phases I investigated the idea of storytelling as a vehicle for personal and relationship transformation. The next phases explored the outcome of colleagues using a storytelling workshop. In my own groups I utilised the success of the workshop but altered the selection of participant groups, exploring any links between the story content, achievement and ability in school mathematics.

1.5 The Structure of this Thesis

I have used the chapters to develop a journey through the research and a development of the key themes that the data suggests were at play in my mathematics classroom. The key themes that presented themselves throughout the data are a) the way students view mathematics which I have called the faces of mathematics, and b) the classroom culture of learning school maths, these particular areas forming the foundations of memorable stories that my students shared as data.

Chapter 2 is the resulting literature discussion from applying step 2 of my intuitive inquiry process. It discusses the different ways mathematics can be viewed and sets out to argue that mathematics is a unique school subject. What mathematics is and who does it is influenced by political, cultural and social influences and the reality in the classroom is that the study of mathematics is influenced by factors that can seem elusive and abstract. Within this chapter I look at literature surrounding factors such as motivation and belief, factors that often influence the learning of mathematics.

Chapter 3 argues the place of stories as a powerful tool for communication (Owen, 2001). In this section I share literature that fuelled my belief that collecting data through the medium of storytelling would provide me with rich insights into the social side of learning mathematics in school. This same literature informed my understanding that developing a personal mathematics story could have the potential for transformation, by this I mean that the process could transform contradictory experiences into more life enhancing experiences.

Chapter 4 describes the methodological influences that have underpinned and guided my research design and facilitation, followed by chapter 5 which describes the three data collection phases of my action research method of working. Chapter 6, 7, 8, 9 and 10 explains my thinking and intuitions about the student stories and how my developing understandings influenced subsequent classroom practice. These chapters also describe the developing intuitive inquiry model of analysis that I adopted and why this was appropriate as a way of working on my data analysis.

Chapter 7 presents data from the phase 1 pilot stage of the action research and my subsequent thoughts and analysis. Chapter 8 presents data from the phase 2 cycle of the action research. This data is in the form of student stories chosen for their influence on my teaching practice and contributions from colleagues regarding the use of stories in their own classrooms. The data analysis takes the form of a thematic analysis way of working and an intuitive inquiry narrative contribution.

Chapter 9 applies the ideas in the previous chapters to the analysis of particular groups of students and stories chosen in phase 3, this analysis is supported with verbatim student story and my own diary extracts. It explains the themes that became visible to me as I worked through the data and the influence that they had on my practice. The teacher story, included as data, explores my influence in selecting those areas.

Chapter 10 draws together the themes that emerged from each phase of the research and seeks patterns and repetition, collaboration and consistency drawing to a conclusion the main data influences.

Chapter 11 concludes the research story and highlights for the reader my contributions to practice and reflects on some possible future applications of the research and the value of the stories for school development.

In the next chapter I present ideas relating to views of mathematics and what it is to different individuals. I discuss various factors that can influence the commitment of students to engage with mathematics and where these ideas fit with my thinking and research development.

Chapter 2: Complexities of School Mathematics

2.1 Introduction

In this chapter I would like to present to you literature relating to what mathematics is and the factors that influence the learning of school mathematics. This literature has been selected to support a variety of ideas about mathematics that have surfaced during my interpretation of the student story data.

I have been asked by other researchers to justify why I think mathematics is different from other school subjects. It is a valid question and I would like to draw on the material presented from other authors, and my own experiences, to put forward and justify the argument that studying mathematics holds a very unique position in comparison to many other current school subjects that the typical school student has an opportunity to study. I suspect, that the reasons that mathematics stands out from other school subjects, will inevitably underpin this research.

My experiences of listening to adult stories has influenced my thinking that, for some people, learning school mathematics has left them with uncomfortable memories of failure, inadequacies and injustices. In addition, my career as a mathematics teacher has presented me with the opportunity to study a variety of students, of differing age and ability, engaging with school mathematics. I have encountered many situations that have led me to believe that it is common for students, when faced with a task that seems to them to involve mathematics, to down tools and deny that they possess any mathematical ability, subsequently underperforming considerably in any mathematical interactions that follow.

Mathematics is often labelled as a difficult subject by children and adults. In many cases they have come to this deduction by drawing on their own experiences, or by accepting the opinions and observations of others. Mathematics is seen as a highly cognitive subject that often demands a level of determination and perseverance from its users (Boaler, 1999). It is exacting in as much as it has answers that most see as the ultimate goal when doing mathematics and it is most usually these answers that gain the rewards and satisfaction. Mathematics consists of a vast bank of connected knowledge, each mathematical concept supporting and underpinning other more complex mathematical concepts, creating a whole body of knowledge. Success in mathematics is dependent on systematic, cumulative learning with each new skill being underpinned by solid foundations laid at earlier stages (Borovik and Gardiner, 2006). This means that a gap in mathematical knowledge at any stage of a learner's development can lead to large holes in latter understanding. There are a number of scenarios that can occur which may cause a student to have a gap in knowledge and I will mention a few that are commonplace. These influencing scenarios can be one or more of the following; poor student attendance; a large number of temporary teachers leading to a lack of consistency in teaching; inadequate teaching by a practitioner with poor subject knowledge or weak classroom management; a lack of confidence on the student's part to communicate that they do not understand something. Another area that compounds the difficulties that students face when learning mathematics is the transition from concrete representation to abstract representations. How materials are used and the ability of the teacher to negotiate their differing interpretations would appear to be important factors in helping children translate their thinking processes from handling objects/using images to symbolic

representations. Children need to see through the objects to the mathematics which underpin the representation (Harries and Spooner, 2000: 46). Kamina and Iyer (2009) suggested that one of the most important uses of manipulation in a classroom is to aid a learner to make connections from a concrete object to its abstraction. In their study of trainee mathematic teachers they found that many 'often encounter difficulties transferring knowledge from enactive manipulatives to math symbolization and abstraction' (Kamina and Iyer, 2009: 2). Post (1981) in a study looking at the role of manipulation in mathematics teaching, suggested that the use of manipulatives is often seen as playtime. With this view in mind, it was suggested that the use of manipulatives were often built in to an activity to add fun and variety rather than as a means of acquiring a deep, long term and secure understanding of the mathematics. Post (1981) also suggested from his study, that the systematic use of manipulative materials is often more difficult for the teacher than working with a program designed around textbooks and exercise books, and in reality concrete manipulatives are used more with younger students. As a result of transitional problems and classroom management and control, Post (1981) found that many teachers gave up using manipulatives for concrete representations prematurely, thus missing the opportunity to lay the foundations for the later use of mathematical symbols and concept building.

Many of the perceived difficulties when learning mathematics can be addressed if the student is in the care of an effective mathematics teacher. Boaler (2009) outlined her expectations of an effective mathematics teacher as a teacher with good mathematical subject knowledge and teaching qualifications, one that understands the steps needed to develop mathematical knowledge and mathematical language.

This is a teacher that knows how to elicit mathematical thinking through effective questioning, and someone who can steer students through times when they lack confidence in their own ability. One that understands the role misconceptions in the learning of mathematics and by the use of considered, constructive and informed feedback can help a student recognise good progress and suitable goals. A professional practitioner willing to think deeply about the mathematical needs of the students in their care, looking for missing building bricks in the wall of conceptual knowledge that forms the foundations of mathematics, and one that can highlight the links between school mathematics and what is mathematics in everyday life.

One thing that has stood out through all the data collection phases of this research is that mathematics is viewed by learners in many different ways. There are examples within the student story data which show contradictions such as, they like mathematics and dislike mathematics in the same time frame, it is a useful thing to know yet it is a waste of time trying to do it, mathematics is said to be good and bad in the same sentence. In the same manner I have witnessed adults proclaiming that they cannot do ‘maths to save their lives!’, but I observe them using mathematics expertly in their daily functioning. It is as though mathematics can change the face it presents in a flash, or it can wear an invisible cloak being visible only to seasoned watchers. The different faces that mathematics can present, has been a theme that has occurred throughout each phase of the research and the purpose of this chapter is to explore the literature surrounding these views of mathematics.

2.2 The Faces of Mathematics

It was during a reading of Reiss et al (2011) that I started to consider the different faces of mathematics. They were discussing the gap between A- level mathematics and university mathematics, and how unprepared the students seemed when entering university. ‘Mathematics has always had two faces. It is a tool in the study of the sciences, and it is an object of study in its own right’ (Hoyles et al, 2010:841). Hoyles et al (2010) acknowledged that many who teach mathematics think of it as the latter face, yet often students are attracted to the subject by the other face for many reasons, including the influence that holding a mathematics award can have on future employment. Students who arrive at university without an appreciation of the two faces of mathematics often find themselves confronted with a subject that they do not recognise. This led me to ponder on the different faces that mathematics presents to my students and, if perhaps, a student finds themselves confronted with a subject that they do not recognise. I felt that investigating student stories about learning mathematics could help me understand what mathematics means to them and whether the faces they see, conflict with the faces that are presented through the school mathematics curriculum, and with the face that I, the teacher wishes to convey in my teaching.

I consider that mathematics has been created by society, and subsequently society has been created by mathematics. By this I mean, that the needs of society decides what counts as mathematics, yet the discipline of mathematics has enabled what we view today as a technological society. Technology cannot develop without mathematics, yet mathematics does not exist without people and is developing and evolving through technology. Mathematics is woven into every aspect of our lives

and is an integral part of functioning in society, ‘Mathematics pervades human experience and makes an impact on nearly all spheres of life’ (Wood et al, 2009:1).

How one thinks about mathematics education, how one defines what it means for students to know and do mathematics in school, is influenced by ones views about the nature of mathematics, ones underlying epistemological perspective and one’s educational goals. This places pressure on teachers of mathematics to reflect on what they do and say when they teach mathematics because how they define mathematics will influence what they teach and the way it is presented. Padula (2011) felt that teachers needed a view of mathematics that is sufficiently broad and able to evolve, and they needed to demonstrate a firm conviction that mathematics is inherently interesting. I personally think that a place to start when debating what face of mathematics we present to students is by asking ourselves, what is mathematics and when do we know we are doing it?

A view of mathematics that is common amongst students and their parents is that mathematics is powerful and important because a grade in mathematics is often used as entrance criteria for educational establishments. Clearly you need more than a mathematics qualification to earn your place at university, but for many students it is the one subject that holds them back from entering further education, and as such becomes a gate keeper to certain careers. Gates (2004) argued that any activity can serve to demarcate between those who can and those who cannot, but he suggested that the particular strength of mathematics education used as a tool to promote inequity and injustice, is the way in which it encourages us to think that the

divisions between those who can do mathematics and those who can't is perfectly natural and legitimate. I have first-hand experience of students unable to enter their choice of work place or take up their preferred place of study, not because they lack the appropriate capability but simply due to their grade in mathematics. This supports the argument that Gates (2004) put forward and highlights the powerful role that mathematics plays in access to school education and post school selection.

Mathematics appears to have many faces dependent on who you are and where you are situated in your school career. Mathematicians, a genre within which I will include teachers of mathematics, describe mathematics in a number of ways. Boaler (1999) described mathematics as a flexible subject that encourages you to think, and mathematical activity as a variety of mental methods such as cognitive wrestle and creativity. This supports an earlier description by Ulam (1976:54) who stated that 'mathematicians wrestle with cognitive problems that have no clear solution paths.' Devlin (1994:3) attempted to define mathematics by looking at some common features that characterised the activities that mathematicians are occupied with, 'mathematics is the science of patterns', and then expanded on this by saying that the patterns that mathematicians study could be numerical patterns, patterns of shape, and patterns of motion. Hardy (1940) also spoke of patterns, but made no attempt to split mathematics into categories, he described the patterns of mathematics as one made with ideas, contrasting this with the patterns of painters made with shape, and those of a poet made with words.

> The mathematician' patterns, like the painter's or the poet's must be *beautiful*; the ideas, like the colours or the words, must fit together in a harmonious way. Beauty is the first test: there is no permanent place in the world for ugly mathematics (Hardy, 1940/1992, p. 85, emphasis in original).

I have heard, first-hand, mathematics described as beautiful, mostly by adults who I would describe as accomplished mathematicians. However, I was told by a student that mathematics was beautiful and they were referring to its link with art and in particular work leading to the generation of fractals. Dietiker (2015) suggested that mathematics classrooms should take advantage of the potential aesthetic opportunities that mathematics offers. He also suggested that mathematics classrooms should celebrate discovery and surprise, encouraging students to wonder, imagine and explore, encouraging aesthetic ways of knowing. Eisner (2002) described aesthetic as a response to an experience, explaining that aesthetic is contextual. The effect of an event or object may seem moving in a particular context. An object or event can be viewed as aesthetically pleasing to one person but may have the opposite effect on another. In the case of mathematics, Burton (1999) felt that aesthetic involves the sensing of value and truth and is the essence of what it is to think mathematically. Dietiker (2015) suggested that aesthetic can be the motivating influence that can engage students through challenges and setbacks, explaining that the aesthetic guides decisions, motivates the pursuit of certain lines of enquiry and helps sense the correctness of a solution. A classroom culture that values aesthetically rich learning would enable students to notice, imagine alternatives, appreciate contingencies and foster experiences such as pleasure and pride. In terms of exploring mathematics, I believe that the aesthetic way of knowing is the root of what mathematicians are describing as ‘beautiful mathematics’. It seems to me that there is a disconnect between the aesthetic for those who study mathematics for pleasure and the experience of most school children and I would encourage a freedom from the tame, harnessed approach of school mathematics to

the spontaneous imagining, surprise and enjoyment of a culture of school mathematics that recognises and nurtures the aesthetic interpretation.

Devlin (2000) proposed that mathematics and music are both creative acts, explaining that when you are sitting with a bit of paper creating mathematics, it is very like sitting with a sheet of music creating music. He went on to explain that it is about the world we live in, it is about ideas, and far from being dull and sterile as it is so often portrayed, it is full of creativity.

Robinson (2006) suggested that mathematics is three separate things that are interconnected and complementary. These are mathematical tools, skills and problems. Examples of mathematical tools include percentages, Pythagoras theorem, rules of algebra etc. Examples of skills include interpreting, proving and generalising and examples of problems would start the sentence with; How many……? Can you find….? What is ….? Sometimes a tool will suggest a problem and sometimes problems encourage us to discover a skill or a tool. Robinson (2006) felt that teachers comfortably present tools to their students but they find teaching a skill difficult because these need to be modelled. Taking these opinions into account then sets a challenge for teachers to develop problems that are sufficiently interesting and engaging, which in turn, would develop the aesthetic stimulation.

On a personal note, I can describe the pleasure and interest I feel when faced with a challenging problem. I can appreciate the satisfaction I feel when manipulating a clever algebraic problem, and I find it aesthetically pleasing to see geometrical forms in buildings and art. Yet I cannot pin down exactly what mathematics is for me, only

that it is everywhere, I plan my day with it, I organise my routines with it, I solve problems with it, I fill my pleasure time with it and it forms the foundations of all the scientific principles that I understand and helps me grapple with those that I do not understand. Because of the way I view mathematics, I hold the belief that it is virtually impossible to function well in our society without being mathematical at some level. I endorse the claim by Devlin (2000:1) that all people everywhere have 'a mind for mathematic', and that every human being with a functioning brain has 'an innate facility for mathematical thought' (pxvi).

Ernest (1990) also described mathematics as a domain that transcends any individual perspective. Mathematics is not a static knowledge domain, an external thing to be internalised by a learner, but rather a socially created, culturally dependent, fallible domain, This was reiterated by Boaler (2009:17), describing what she believes is mathematics in a more global sense: 'Mathematics is a human activity, a social phenomenon, a set of methods used to illuminate the world; it is part of our culture'.

Why then is it commonplace to see people crumble in the face of a mathematical problem? What do our students think mathematics is and how do they feel when faced with what they perceive to be a mathematical problem? When do people become mathematicians and how do they know that is what they should call themselves? Wood et al (2012) explained that becoming a mathematician involves not only learning mathematics, but also becoming aware of the mathematical way of looking at the world, and the role of mathematics in professional and personal life.

One outcome of this research also highlighted the fact that students see mathematics in a number of different ways. Woods et al (2012) supported the idea that people hold different views of mathematics. He explained that in the narrowest view, mathematics is seen as being based on techniques and components, while the broadest view appreciates the part mathematics plays in personal and professional life. Woods et al (2012) argued that the role of the mathematics educator is to help our students follow the path of becoming mathematicians by taking time to talk to our students, helping them explore the range of mathematical faces, and enabling them to appreciate the role of mathematics in their lives.

2.3 Mathematical Knowledge

Greer & Mukhopadhyay (2003) suggested that the answer to the question, what is Mathematics is generally considered to be unproblematic once you accept that there is a fairly unified body of knowledge called Mathematics. However, they suggested that we should question the relationship between this body of knowledge and what we select to teach in schools. School children are exposed to a fraction of this large body of knowledge and Greer & Mukhopadhyay (2003) felt that we should question who makes the selection and on what basis this selection is made. They raised the point that we should be concerned about 'the gap between school mathematics and the lived experience of students and the adults that they become' (Greer and Mukhopadhyay, 2003:2). This point raised by Greer and Mukhopadhyay (2003) concerning the choice of mathematics that is presented to our learners concerns me on two levels, one at the functional personal level and the second at an institutional and political level. My first concern is that if the mathematics we teach in our classrooms bears little resemblance to the life skills that our students need to

negotiate their financial, social and leisure interests, then it is not surprising that they might find mathematics foreign and alienating and perhaps a subject that they have no affinity with. Noyes (2009) felt that teachers needed to develop pedagogies of both access and dissent so that mathematics education is more equitable and socially beneficial for everybody, and that the school mathematics curriculum should be rethought so that what all students should learn at each stage is given priority over the special needs of a few. My second level of concern is one that is wrapped up in issues of equity, equality and well-being, and concerns the development of the school curriculum. I have experienced the different changes that have been applied to the school mathematics curriculum over a period of approximately forty years. The reality for me, the teacher, is that the mathematics curriculum and its changes have been unresponsive to any changes that have been taking place in the immediate environment. The explosion of technology as an information source, a communication tool and social tool has had no real impact on the content of mathematics curriculum. Pertinent issues that affect the well-being of society such as social injustice, environmental changes, global economy including the distribution of world wealth and power are not integrated explicitly in our school curriculum. These topics are left to the discretion of the classroom teacher, who often under pressure and overworked, has to find the time, energy and resources to deliver a unique curriculum through which they can help their students develop mathematical power. As it stands, I feel that the school mathematics curriculum has become a bit of a dinosaur, it is steeped in history and a particular type of culture, but any changes to its content have been superficial and insignificant. Greer and Mukhopadhyay (2003) suggested that mathematics education should be viewed from the perspective of a different value system, and that the most important reason for mathematics

education is to make accessible to many people powerful mathematical ideas which can be used as conceptual and critical tools to analyse issues relevant to their lives

Martin et al (2010) also posed questions about what counts as mathematical knowledge and who should decide. They also argued that instead of school mathematics being used to stratify students, affording privilege to some and limiting opportunities to others, it could also be used as a tool to understand the world, and, in the case of marginalised students, it could be used as an aid in understanding the social forces that contribute to this marginalisation. Clearly mathematical knowledge consists of mathematical content and research surrounding mathematical content can produce new mathematical knowledge, but there is other research about mathematics that can also produce new mathematical knowledge. Understanding how and why children interact with mathematics content, as well as how and why they learn is not a question of mathematics content alone. Research that probes into the complexity of learning mathematics, the social realities of the learners, and the forces affecting these realities have a vital place in my quest to gain new mathematical knowledge. Research surrounding issues such as identity, language, power socialisation and racialisation within the remit of mathematics education are vital for producing new mathematical knowledge that is broad, robust and useful to a wide range of mathematical learners. Martin et al (2010:20), when considering particular mathematics learners, demonstrated how context produces different knowledge, and therefore why asking ‘what’s the context?’ is important. Asking students to share their stories about learning mathematics provides knowledge that will help the reader appreciate the unique forms of context experienced by our students.

Some of the stories created by my students presented mathematics as a powerful object that can act on you. The ideas of Foucault stated that it is not possible for power to be exercised without knowledge, and it is impossible for knowledge not to engender power (Gordon, 1977). I feel that the power play between the mathematical knowledge considered valuable by the education system, and that of the community, should be considered as one of the factors that makes a mathematics classroom unique, and is a key concept underpinning the negativity that much of society displays when recollecting their experiences of learning mathematics.

> Mathematics education, as an enterprise, benefits from a variety of research perspectives and approaches. Nevertheless, mathematics should not be the gatekeeper for the production of knowledge in the field (Martin et al, 2010:21).

Meaney (1999) suggested that power operations are the acceptance and validation of knowledge and in order for collaborative behaviour to occur there needs to be a sharing of knowledge and purposes. These behaviours can only develop from trust, built up through social relationships over time, hence, in order for a classroom to be effective, the teacher needs to ensure adequate time is set aside to build up social relationships and share knowledge. Zevenberg (1996) claimed that it is possible to see this power play operating in mathematics education. One example of this is how society has influenced what is mathematical knowledge. The abstract qualities of mathematics have been valued so highly by society that the passing on of this knowledge and way of thinking have been rigidly controlled. Therefore, mathematics education has concentrated on improving students' chances of learning this mathematics rather than improving students' ability to critique the role mathematics

plays in society. Chomsky (2000) was concerned about the lack of graduate programs in mathematics education that contain a class on the political aspects of mathematics education and he suggested that the establishment of such classes might be a good way to start if change is to occur within the field of mathematics.

2.31 Learning Mathematics in School

There are many forms of knowledge brought by students to the classroom. Knowledge about mathematics and how it is learnt, knowledge about teachers and schools, knowledge about themselves and their positioning with regards to ability, friendships, power relations and self-worth, and knowledge about the world outside of the school and their own (and perhaps other) cultures. This knowledge is what they know at that particular time and is the truth as they see it, it cannot be static as that would suggest that they cannot learn, instead it is malleable and open to manipulation by many variable forces. The phrase ‘I don’t know’, sometimes uttered in a mathematics class by students, is perhaps an indication of the tensions that are acting on their knowledge. Yet, this phrase is one that often produces frustration on the part of the teacher who assumes they do know, but are unwilling to say. I think maybe we should consider that at that moment they do not know, because what they did know is in turmoil and being reshaped as they speak.

When I hear people say that they are not good at mathematics or they cannot do it I can only conclude that people do not always know when we are doing mathematics. My premise is that people do not recognise mathematics in their everyday lives, and that the definition and descriptions of mathematics and mathematicians that they apply to their everyday practice have been constructed from experiences and

histories that possibly do this vast subject an injustice. This deduction is drawn from the knowledge that all around me I see people demonstrating abilities that I can only describe as mathematical, and actions that would indicate that they enjoy mathematics. Films depicting mathematics and mathematicians such as 21, Beautiful Mind, Good Will Hunting were all box office hits, and the mathematical television show NUMB3RS draws a large audience. It is fairly common place to see somebody on the tube working on ancient Japanese puzzles such as Sudoko or Hanjie, and indeed the British Newspapers usually contain one of these puzzles alongside the crossword. Yet in this same society, people can be openly vocal about their inability to do mathematics, and their general dislike for the subject. In this sense mathematics is being treated as an object, something to stay clear of, something that does not necessarily belong to the general body of people, and more importantly something that we can do without. Devlin (2000:3) suggested that 'mathematics is a woefully misunderstood subject' and this is the reason that many people feel uneasy about it.

When I reflect on why I have been driven to embark on an area of research that attempts to get to grips with how our children feel about their day to day experiences of mathematics, I start to dwell on particular events that I have observed repeatedly throughout my teaching career. To help the reader interact with the text and reflect on key aspects of this classroom event I will utilise a narrative. The diary notes were written a few hours after one particular event and are not an exact account, but I have attempted to conserve the essence of the interaction. The student name has been changed to preserve anonymity.

2.4 My Diary Extract

The students enter the classroom, chatting amongst themselves; they appear happy, animated and lively. They move to their designated seats- not chosen by me – but by some silent selection process that is constant each lesson.

"Good morning" I say to them and smile, most of them reply although some are still immersed in the conversation with their friend.

"Ok, let's get started; please make sure you have your maths books open and the date written". There is a general settling period and conversation between us regarding the removal of outdoor garments.

I start the lesson with a brief outline of what we are going to work on today, and where it fits with the general plan of yesterday's lesson and subsequent lessons. The topic is standard form, and this is the second lesson. Yesterday I introduced some of the skills needed for applying standard form, why standard form was useful and where, and the basic principles involved in putting various numbers into and out of standard form.

I start with a power point presentation to recap on the basics of yesterday's lesson; this includes some questions for the class to practice the work. All is well, the class is engaged, a variety of students have asked questions and others have contributed answers, including Aisling, a student in this class. My assessment of the situation after this starter is that all of the class will be able to work on an exercise that I have selected from the text book.

The class are given their assignment, and I start to walk around talking to the students, asking questions to enable me to get a handle on any misconceptions that might arise.

I heard "I don't understand, I can't do this" almost immediately, but I chose not to look in the direction of the speaker. It was a common phrase often uttered in the maths classroom and my urge was to give the owner space to think and sort out what I was asking them to do. The class culture that had been established during our time together is that they could always choose to work with a partner, so I assumed another student would step in to help.

There was a general hush from the students on one side of room, I could hear muffled speech but not the content, they were looking towards the seat that Aisling occupied and they seemed uncomfortable. This was out of character for this class, they were usually a lively, collaborative group, who liked to discuss their answers and seek ratification from fellow class mates. My attention focused on the back row, Aisling had buried her head in her folded arms, and it was possible that she was crying silently, her face was obscured from my view.

"Please get on with your work" my irritation was beginning to surface. This girl had clearly demonstrated minutes earlier that she could indeed answer the questions, what could possibly be the matter?

I moved on to look at a student's work, still fighting the urge to be cross with Aisling, (but common sense prevails, after all, who is the adult here?) Fairly quickly, I sat down next to Aisling, "What is wrong? Please sit up and speak to me!" Aisling, sullen and quiet, sits up but does not speak, she is clearly upset. I

start to explain the work, the explanation is similar to the one executed a little earlier to the whole class, but I speak quietly and in a gentle manner. Aisling responds by answering my questions about the work and then starts to work her way through the set exercise. The episode is over, and ignored by all as though it had never occurred, the class returning to their usual vibrant behaviour.

I tell this story because it typifies the nature of an event that happens over and over again, in different mathematic classrooms with different students working on different areas of mathematics. The behaviour of the students differ but they exhibit some similarities, they all appear to experience some sort of shut-down, (blind-sightedness), when asked to apply mathematics that they have previously shown competence in. With this short episode in mind there are a variety of ways to interpret the relationships at play between Aisling and her mathematics. Are the influences that cause this phenomenon located within Aisling's self? An inner voice which speaks and says "this is not me, I cannot do this." Thus allowing the classroom environment to cause her to collapse and withdraw into her shell. Leaving a 'small' person outside who does not interact and so cannot receive emotional blows such as embarrassment and failure. Or is Aisling in fact standing firm and allowing her inner voice to say "this is not where I belong, none of this applies to my world, this work has no worth", placing the fault squarely with the environment she is situated in, namely the mathematics, the class or the school, and the teacher? What is the role of Aisling's peers? Was this apparent shut down due to a comment made by one of her class mates, or perhaps a particular comment or display of body language made by me? It may possibly be the result of a 'non successful episode in the mathematics classroom' the previous day, week or month, not memorable to me but loaded with emotion for Aisling. What is clear to me is that I would be able to work with Aisling more effectively if I knew more about what she was experiencing when asked to take part in this social act of doing mathematics. This interpretation

became the impetus for my particular form of data collection - student stories about learning mathematics. Reflecting on Aisling's behaviour addressed an aim of my research which was to gain a deeper understanding of the less visible influences that are at play when students take part in a mathematics lesson. This reflection coupled with my literature search led me to consider two further questions related to student's learning mathematics. These were: where does the 'self' fit in learning school mathematics? And where in the learning of school mathematics can you insert your culture, history, personality, and aspiration desires? The position of some of the other subjects taught at school, for example, English, History, Geography, Sociology, naturally encourage us to think about our origins and connections and create space for the student, to explore the self. Mathematics makes little room for these connections, and the expert language that surrounds mathematics makes communication for all but the most able particularly difficult. Reid and Solomonides (2007:30) described a student's 'Sense of Being' as their ideas and feelings about themselves in relation to other things. A core feature of the research undertaken by Reid and Solomonides (2007) was that the student's suggested that a 'Sense of Being' predicates their engagement with their discipline and the ways in which creativity is perceived and manifested. This sense of being in relation to mathematics is often termed 'mathematical identity' and many studies have investigated the relationship between this and engagement. I believe that asking student to share their mathematical stories can give them a medium through which they can explore their identity within the world of learning mathematics.

2.5 What Students Bring to the Mathematics Classroom

So what do students bring to their mathematics lessons, and is the situation unique to mathematics? I have often heard teachers use the terminology of student

‘baggage’ to explain the presence of an unknown influence that seems to dictate the way a student behaves in their interactions with others. This ‘baggage’ seems to determine their attitude towards certain subjects and learning situations. ‘Baggage’ for the purpose of this paper can be thought of as anything a student brings with them to a mathematics lesson that influences their participation and engagement. We might then describe this as all objects brought to the mathematics lesson, as long as we keep the definition of objects broad. I will use the definition offered by Walls (2003) which is that an object is anything that can be indicated or referred to. This idea has been taken from a symbolic interactionist viewpoint, which has been derived from a sociological attitude (Blumer, 1969), and has been used in educational research that attempts to probe into the hiddenness of the structures and processes that generate a child’s mathematical world. (Walls 2003, Woods 2000, Reay and William 1999, Yackal and Cobb 1996). Through the work of Blumer (1969) and Walls (2003), I began to understand and appreciate the symbolic interactionist perspective that objects are given meaning and understood only through interaction with others. Using mathematics as my example of an object, the student comes to know and label mathematics through its daily use in the mathematics classroom, through the daily interactions between peer groups and mathematic teachers, and through interactions with home and society outside of the classroom. The interactions give the object its meaning and what is acceptable as being labelled mathematics is ratified by the curriculum and the mathematics teacher. Although all the class will use it, the meaning associated with this object can differ from student to student, which will become evident as you work through the stories of my mathematics learners.

My experience as a teacher has been that students do not come to the mathematics classroom as a blank canvas; they bring with them a range of expectations and behaviours that have been constructed around the interpretations of events from schooling, home life, relationships, social interactions, media and their own imaginations. This complex web of life experiences, defines for them what mathematics is, who does it, and where they are placed (if at all) in the mathematical world in which they are expected to succeed. The evidence from the student stories suggest that there is an interesting interplay between beliefs and behaviours and how these aid or hinder access to learning mathematics.

It is widely accepted by researchers such as (Boaler 2009, Reinup 2009, Yackal 2004), and a firm belief held by me, that a person and his/her relationship with mathematics is a complex phenomenon, which includes knowledge as well as beliefs, emotions and attitudes. Each concept contains aspects that can support the learning of mathematics, and in addition aspects that can create barriers to mathematical learning. It is clear to me that if the latter is not addressed, it could slow down mathematical learning for a particular student. Through the stories of my mathematics students, I have begun to understand a little about the complex forces at play that influence access to social interaction and mathematical learning in my classroom, allowing me to reflect on and adjust my practice accordingly.

2.6 Invisible Influences

To investigate this complex web of relationships within the context of invisible influences, I have chosen to focus on four factors which contribute to this concept of invisible influences, these are: knowledge, beliefs, attitude and identity. For the

purposes of this research I will address these factors in the context of mathematics and the related teaching and learning of mathematics. Influencing the above concepts and inevitably entwined with their formation are other things which the students negotiate on a daily basis, these include aspects of social conditions, institutional arrangements, expectations, conceptualisations, forms of discourse and positioning. As Pollard and Filer (1999:20) put it, ‘we need to complement this with a study of the activity of children as they negotiate within these constraints and possibilities’.

I would like to state my belief that, although some of the invisible influences that student’s bring to the classroom is generic across different subjects, the situation in a mathematics classroom is unique for reasons that are explored in this paper. Many students have preconceived ideas about school, their teachers, classroom dynamics, etc. and bring them, along with their associated actions to the school forum. But, for me, the distinguishing feature about a mathematics classroom is how common it is for students to experience a struggle within the context that they have been asked to function in, and how acceptable it is to voice and make known to all, this struggle. My belief in the uniqueness of mathematics as a school subject underpins my framework and methodology for the research, and strengthens my conviction that, to improve the learning of mathematics, it is wise to look at what happens in the classroom from the perspective of a student, an angle that is different from that of many of the other traditionally accepted mathematics research studies.

My research design is guided by the assumption that what children carry with them into the classroom situation differs from child to child, they will have different feelings about themselves as learners, about the sorts of relationships they can have with teachers. They carry different experiences of the wider school beyond their classroom, some will view it as a place for learning, developing and enjoying a wide range of interests and skills, others will not. They will have different perspectives on, and in, the various friendship groups within the peer culture of their class, and how they define themselves and their place within that culture will differ. Their particular sense of self, as clever or slow, acceptable or different, liked or disliked, someone who leads activities or is exposed by them, will vary from child to child, shaped by their past histories and present experiences.

2.61 Beliefs

The idea of a belief is given different meanings according to different researchers. This is understandable due to the fact that notions such as beliefs, emotion, conception and motivation are not directly observable, and their meanings are often interpretations at play between the story teller and the interpreter. My aim here is to give a brief flavour of my understanding of beliefs and the power they can play out in the mathematics classroom.

Research has shown that there is a relationship between pupils' learning outcomes in mathematics and their belief about their mathematics. Leder et al (2002), Schoenfeld (1992), and Thompson (1992) are some of the researchers who have studied mathematics and student beliefs. Leder et al (2002) described beliefs as

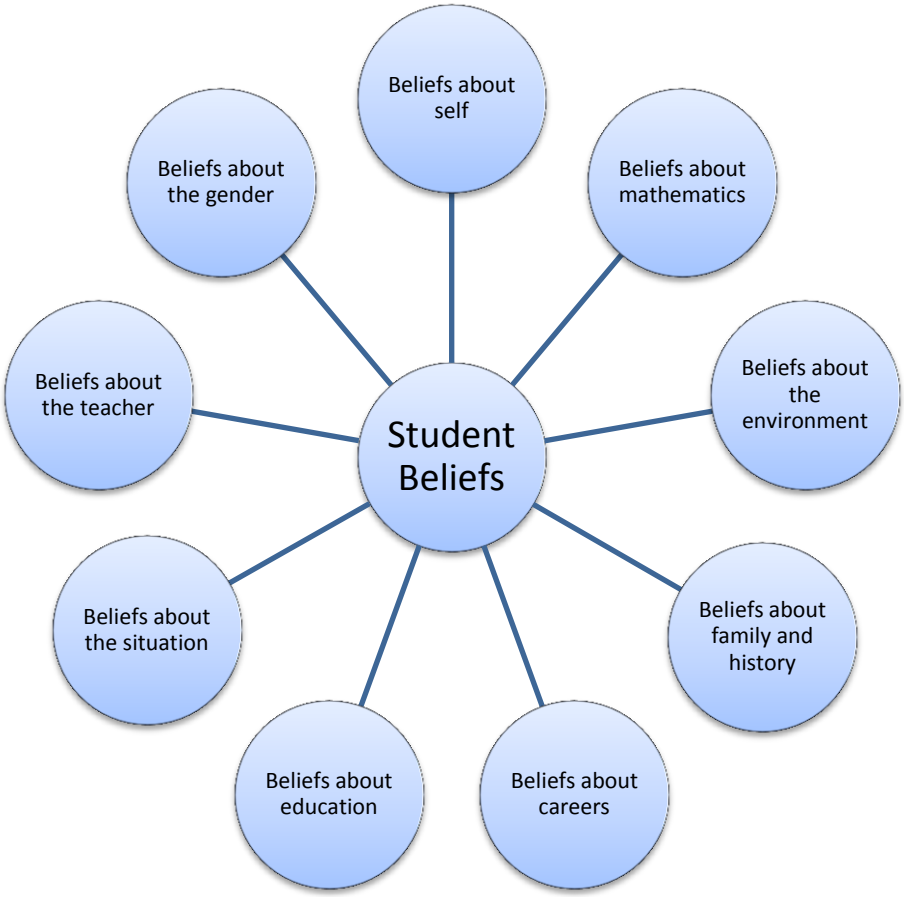
psychologically held understandings, premises or propositions about the world that a person feels to be true. He goes on to add that the first time a student perceives and understands a notion they implicitly accept it as a truth. This truth is knowledge as we understand it and it seems to be one of the basic mechanisms characterising the functioning of our mind. We start by uncritically accepting and believing everything we see or hear. If we accept this fact then it shows that at a very basic level beliefs are grounded in the social contexts within which one functions. Taking this view, beliefs are a product of social life; they are a functioning of the classroom practices in which one participates, all uniquely influenced by social contexts such as family, peers and groups. A students ability to think and learn operate together (Op t Eynde et al, 2002), a student's problem solving behaviour is always directed by what they believe to be true, referring to knowledge as well as beliefs, hence beliefs and knowledge are closely related constructs. From an epistemological perspective, beliefs are an individual construct while knowledge is essentially a social construct;

> Knowledge requires a truth condition. Beliefs are independent of their validity. This truth condition entails an agreement in a community that a certain proposition is true and has met the criteria of truthfulness in that social context. This consensus gives it its higher epistemic standing. Knowledge goes beyond an individual and is situated in communities of practice. It is distributed in the world among individuals, the tools and the books they use (Op t Eynde et al*,* 2002:23).

Knowledge and its tightly bound relationship with beliefs, determine what a child views as mathematics, what constitutes doing mathematics and whether they should take part in the activity of doing mathematics. Martin (2000), during his research on equity in the mathematics classroom, found that some students did not believe that they were doing mathematics when they engaged in activities that were not text book or worksheet assignments. Some did not view mathematical knowledge and learning

as important, and by displaying strong negative attitudes towards school and mathematics made it difficult for other students to disclose that they liked mathematics, and that they were capable at it. A consideration of the beliefs at play when a learner takes part in a mathematics lesson produces a complex list of belief influences at play (Figure 1), all contributing to the choice of actions implicitly or explicitly executed by the student. Figure 1 below, breaks down relevant student beliefs into subheadings, each subheading is inter-related with the others and gives rise to a belief system, the area is a vast, complex mental network which is unique to a particular person. Beliefs are organised in clusters around specific situations and context and people always strive for a coherent belief system so that they can function in an intelligent way.

Figure 1: Student Beliefs



Reinup (2009:142) stated that:

> Beliefs do not only influence how pupils learn but may also form an obstacle for effective teaching, which means that people who hold negative beliefs about mathematics become more often passive learners and place more emphasis on remembering than understanding.

A definition of belief that fits comfortably within my understanding is one given by Schoenfeld (1992). He described belief systems in mathematics as one's mathematical world view, a sort of lens through which students view mathematics and learning.

The literature surrounding beliefs and mathematics gives a strong message that suggests that research that effectively captures students' and teachers' multi-faceted beliefs, can impact on mathematical learning and behaviours (Leder 2008). However, the literature written about beliefs is vast so at this point I have chosen to narrow down my search and specify the beliefs that seem to be most commonly at play in my mathematics classroom. These are beliefs about self (self-efficacy), and beliefs about mathematics. This focus on particular classroom affects brought about by these beliefs selects the literature that is pertinent to the topic, and the subsequent discussion that follows needs to be considered as a small subset pertaining to the area of beliefs.

2.62 Beliefs about Self

Students' beliefs about themselves and the causes of their successes and failures in mathematics have important implications for their educational outcomes; these topics have been the focus of research carried out by Middleton and Spanias (1999) and Yates (2002). Bandura (2006) claimed, that an insight into the self-efficacy of learners could be a valuable tool for mathematics' educators. Self-efficacy is the belief we have in our own capabilities and the judgements we make about our potential to learn successfully. The choices we make, the effort we put in and how long we persist, are all influenced by self-efficacy. These behaviours are also used by educators to make assessment judgements relating to a student's performance and as such, the origin and influences of self-efficacy becomes important research data for me. A students past experiences, which I will describe as their histories, shape their self-efficacy.

> Perceptions of self-efficacy come from personal accomplishments, vicarious learning experiences, verbal persuasions, and psychological states (Tait-McCutcheon, 2008: 507).

Bandura (2006) explained that efficacy beliefs influence whether people think erratically or strategically, optimistically or pessimistically, and hence the concept of efficacy beliefs could influence the development of cognition in mathematics. Yates (2002) attempted to measure optimism and pessimism, against achievement in mathematics in a sample of primary and secondary students. She found that although achievement in mathematics was most strongly related to prior achievement and grade level, optimism and pessimism were also significant factors. In particular, students with a more generally pessimistic outlook on life had a lower level of achievement in mathematics over a period of time.

Research by Tait-McCutcheon (2008:507) suggested that 'one way to gain real insight into how our learners feel, think, and act, about and towards mathematics is to examine their psychological domains of functioning: the affective, the cognitive, and the conative'. She explained that the value in examining each domain separately is that a student may feel fairly efficacious within one domain but less confident within another, and hence it is important to be able to distinguish between the factors that could aid or inhibit mathematical learning. The affective domain is a student's internal belief system which includes students' beliefs about themselves and their capacity to learn mathematics; their self-esteem and their perceived status as a learner; their beliefs about the nature of mathematical understanding; and their potential to succeed in the subject. The cognitive domain considers students awareness of their mathematical knowledge, their strengths and their weaknesses.

Conation refers to staying power and survival, and includes the inclination to plan, monitor and evaluate, thus incorporating an element of reflection. In her research, Tait-McCutcheon (2008) referred to some key findings relating to the three efficacy domains.

Within the affective domain:

> There was strong correlation between enjoyment, motivation and success. Students saw liking/ not liking mathematics as the beginning of a cycle of success or failure. Students sought external confirmation of their answers being right or wrong and there was generally a lack of self-regulatory monitoring.

Within the cognitive domain:

> Speed was valued over accuracy. Students identified a need to be finished as more important than the need to be correct. Students related mathematical success to hard work.

Within the conative domain:

> Students valued talking and working with others, but these had to be people you agreed with quickly, differences and disagreements were not seen as valuable.

One fact that has been repeated throughout the literature is that beliefs are very personal, they may meet emotional needs or provide defences from pain, and once established they are difficult to change, however, it is clear that part of the process of changing beliefs must include creating a context in which it is emotionally safe to do so. I believe that good classroom practice, which incorporates considerate and careful relationships with constant reflection, a comfortable medium to explore voice, and due care regarding ethical considerations, all contribute to a context where beliefs can be shared and explored. My desire as an educator to provide an

environment that provides this context is the driving force behind my research inquiry.

2.63 Attitude

According to Ajzen (2005:3) attitude is a ‘disposition to respond favourably or unfavourably to an object, person, institution or event.’ It is a word commonly used by my colleagues in the secondary school setting in relation to students of mathematics and their interaction in the mathematics classroom. It is used very loosely as an umbrella term to explain many of the difficulties that occur between students, their mathematics and the mathematics teacher.

The research investigation of Fiona Walls (2003) began as an exploration of children's 'attitudes' towards mathematics. Her original research questions were: how do children become aware of mathematics as part of their lives? How and why do their attitudes towards mathematics, including their feelings and beliefs about mathematics, develop and evolve over time? She explained that research in this area had developed because of growing concerns that negative attitudes towards mathematics were prevalent at all instructional levels and that she believed that a link existed between attitude and achievement. In this research attitudes towards mathematics came to be viewed as a complex dimension of the learner's life, consisting of a broad range of beliefs and feelings, embedded within the individual's world of experiences associated with mathematics.

The child as a mathematical subject is developing from the day it is born, the earliest mathematical influences would usually come from parents and be enacted in the learning activities that most children encounter, thinking, walking, talking and

interacting with people. But mathematics is not often identified in these processes, for most, the first overt identification of mathematical activities will be in the school classroom. Walls (2009) applied the ideas of Foucault (1967) that as subjects we exist – for ourselves that is – only in the way we enact ourselves, to mathematics education as part of a discursive practice that is seen as more than simply what happens in the classroom.

> We might suppose then that whenever children hear their teachers say “it’s time for maths”, enlist their parents’ help with their maths homework, discuss their mathematics test results with their family or mates, observe a character doing maths in a television show, exchange views with friends about a particular maths teacher, or choose whether to continue their study of mathematics at secondary school, they are at the same time engaged in a discursive process of self-construction as they bring themselves and each other into being as both ‘children’ and as ‘mathematical subjects’ in their hearing, seeing, uttering and doing (Walls, 2009:6).

The social enactments that go on in school under the heading mathematics define what mathematics is for most students. It is at this time also that student’s mathematical identity and beliefs are developed, ‘ a child may experience shifting or contradictory views of the self as a mathematical learner through engagement in pedagogical regimes, interactions with friends and classmates, or discussions with parents and siblings’ (Walls, 2009:12). It is a short leap of logic to assign a positive correlation between a population who are intimidated by mathematics and the role of school mathematics in causing this phenomenon.

Zan and Di Martino (2008) confirmed that attitude is a construct that plays an important role in mathematics education. They stated that much of the research on attitude lacks theoretical clarity, that the measurement instruments are inadequate,

and that many studies about attitude do not provide a clear definition of the construct itself. They explained that research on attitude falls into one of three following definitions. The first definition of attitude describes it simply as a positive or negative degree of affect associated with the subject. The second definition describes attitude as a multi-dimensional construct, which recognises three components: emotional response, beliefs regarding the subject, and behaviour relating to the subject. In the third view, attitude is presented as a bi-dimensional definition in which behaviours do not appear explicitly: attitude towards mathematics is seen as the pattern of beliefs and emotions associated with mathematics.

In the research of Rutfell et al (1998), attitude was experienced as highly influenced by the social and emotional conditions in which it is both perceived and observed. They questioned whether people actually possess attitude and the like, and suggested that these constructs are just categories created by observers who wish to account, by language, for what they claim to see.

In my research, attitude acts as a signal to me that something is happening that I need to explore, and which should be studied in its context because what is important to me is the context that has stimulated the attitude. I believe that a study of attitude within a particular context is useful, and the knowledge gained can inform future practice. Zan and Di Martino (2008) felt that a study of attitude could enhance a researcher's knowledge and understanding of a particular situation and hence is an important unit of measurement that could provide new knowledge.

> This proposition views the attitude construct as functional to the researcher's self-posed problems: in these terms we consider it to be useful in the context of mathematics education, as long as it is not simply borrowed from the context in which it appears i.e. social psychology, but is rather outlined as an instrument capable of taking into account peculiar problems in mathematics education (Zan and Di Martino, 2008: 199).

One main message generated in the research by Zan and Di Martino (2008) was that the simple dichotomy definition of attitudes such as like/ dislike, can do/can't do, stated in the first definition has serious short comings. These themes are intertwined in the subject's vision of mathematics and one single emotional reaction can be associated with conflicting visions of mathematics, often *I like* mathematics is associated with a relational vision, (makes me think, reason, enjoy), and *I dislike* mathematics is associated with an instrumental vision, (rules, operations, right/wrong answers). In the research by Zan and Di Martino (2008) all four combinations of like/ dislike and easy/difficult were found:

> *I like mathematics because*
>
> …*it is easy*: Since primary, I always found mathematics rather simple and easy to be understood. And maybe this is one of the reasons it has always been one of my favourite subjects.
>
> …..*It is difficult*: the story of mathematics in my life started off with logic: sets of fruits, difference between "and" and "or", opposites (like red and not red)….As time was going by the fruits disappeared and notions and difficulties were increasing, and mathematics became more and more interesting and involving and my judgement changed completely.
>
> *I don't like mathematics because:*
>
> ……*it is easy*: In the beginning mathematics was nasty because it was too easy, 3 + 1, 5 + 5.
>
> ……*It is difficult*: I didn't like mathematics much because I saw it was difficult and I did not manage. I gave it up quickly. (Zan and Di Martino, 2008:209)

These results suggest that for a description of pupil attitude towards mathematics it is not enough to highlight his or her positive/negative emotional disposition towards

the subject, it is also necessary to discover what vision of mathematics and what self-efficacy beliefs this emotional disposition is associated with.

2.64 Identity

In considering the invisible influences students bring to the mathematics classroom, I make the assumption that the stakeholders (teachers and students) bring multiple and interrelated elements to the learning environment. For me the concept of identity is the potential that connects these elements, (elements that include beliefs, attitudes, emotions, cognitive capacities and life histories). Broadly speaking, identity can be thought of how an individual knows and names themselves, (I am a teacher, a student, good at maths….), and how an individual is recognised by others, (she is smart, tall, extrovert …). Identity is not something to be discovered, it is not an object out there waiting to be found, it is constructed and developed over time, constantly renegotiated through our interactions with one another and within the context of our culture and life histories. Bauman ((2004) described the anguish, pain and insecurity caused by living in society, as a catalyst for a patient and ongoing examination of reality and how individuals are 'placed' within it. He describes identity as 'an ongoing process of redefining one self and of the invention and reinvention of one's own history' (Bauman, 2004:7).

> One becomes aware that belonging and identity are not cut in rock , that they are not secured by a lifelong guarantee, that they are eminently negotiable and revocable, and that one's own decisions, the steps one takes, the way one acts- and the determination to stick by all that- are crucial factors of both (Bauman, 2004: 11).

It is a general consensus in the current literature that the subject of identity is, by its very nature, elusive and ambivalent. This is not to suggest that it cannot be investigated, but that the approach and consequent interpretation needs to be

recognised as evolving from the different historical perspectives that identity definitions stem from. Two views on identity appear to be particularly significant to my research area and these will underpin my inquiry. The first, developed from a psychological perspective, focuses on the individual, looking at variables that impact on a person's self-concept. Identity formation is seen as largely self-determined as the individual adapts or develops to fit with the events and situations of life.

> As the school child makes methods his own, he also permits accepted methods to make him their own. To consider as good only what works, and to feel accepted only if things work, to manage and be managed can become his dominant delight and value (Erikson, 1969:234).

Erikson (1969) presented the argument that youth is sensitive to any suggestion that they may be hopelessly determined by what went before in history and life histories. This gives rise to the deduction that the influences of family, peer and society in general, could play a major influential role in the development of a student's identity with respect to their possible positioning of themselves in the environment of mathematics. Within this framework it is feasible that the student can feel a need to commit to membership of some special kind (tribe, nation, class, family or type) whose insignia they will wear with conviction.

The second focus on identity formation is influenced by a socio-cultural perspective; in this view identity formation is a social rather than a personal phenomenon. With this perspective in mind identity is developed through social and cultural practices. Identity formation is seen as being steered by society with the individual attempting to navigate predetermined passages (Corte and Levine, 2002). Both these definitions of identity highlight the changing nature of the phenomenon and provide

support that identity should be considered as an ongoing process of redefining oneself and of the invention of one's own history (Bauman, 2004). The behaviour a student exhibits, as a consequence of their perceived identity and self-efficacy, can influence educators to make assessment judgements relating to the performance of that student, and as such, the origin and influences of this behaviour is important research data for me.

2.65 Mathematical Identity

'Mathematical identity is the relationship people form with mathematics and more importantly, with other actors and processes in the environs of mathematics' (George, 2009:201). Students and teachers bring their mathematical identities to the classroom with them, these are products of earlier and ongoing mathematical experiences and these experiences shape their present day processes of becoming.

The notion of mathematical identity, the relationship a student forms not only with the mathematics but also with the mathematical environment, is also described by Fried (2008) as the 'mathematical self', which he states consists of a private entity and a public one. In this way Fried (2008) also acknowledged the two perspectives, suggesting that as educators we need to recognise the importance of both these worlds. Bandura (2006) claimed that an insight into the self-efficacy of learners could be a valuable tool for mathematics educators, and students' beliefs about themselves and the causes of their successes and failures in mathematics have important implications for their educational outcomes (Yates, 2002; Middleton & Spanias, 1999). Self-efficacy is the judgements we make about our potential to learn successfully and the belief we have in our own capabilities. The choices we make, the effort we put in and how long we persist are all influenced by self-efficacy. A

students past experiences, which I will describe as their histories, shape their self-efficacy. 'Perceptions of self-efficacy come from personal accomplishments, vicarious learning experiences, verbal persuasions, and psychological states' (Tait-McCutcheon, 2008: 507).

Formed identities are 'hard won' standpoints from which individuals form self - understanding of, and for, them (Black et al*,* 2009:4), as such they become powerful personal possessions. The identities discussed in Black et al (2009) are generally strong, (whether positive, negative or a mixture). Holland (1998) suggested that not all people develop much of an identity in a particular cultural world as they may not ever be sufficiently engaged by that world to do so. George (2009) also suggested that not all students form strong identities, some students experiences have not resulted from hard won standpoints, they have felt little interest in the topic in question and the emotions involved are low. For others, a breakdown within a student's relationship with mathematics could be caused by the type of learning that is on offer in the school mathematics classroom. In order to be involved in mathematics, some students may find that they have to deny other aspects of their identity, and some students are not willing to make that sacrifice. In these circumstances the learning of mathematics will suffer and the student will never form much of a mathematical identity.

The literature from Black et al (2009) focused on research that probed into the development of the mathematical identities of three people, now adult, and drew from their narratives some interesting perspectives. The three people in question all

had measured success in mathematics (indicated by a variety of institutional results), yet all told stories of feeling defenceless in the face of mathematics and in some ways having to find a space within their nexus of identities for this position. Their mathematical self 'self-knowledge as mathematics beings', is a knowledge of themselves as a kind of creature that does mathematics and shows a tension between its public and private face (Fried, 2008:121).

> It is as if mathematics strips people bare eventually (for many people sooner, for others later), bringing them to a place where they are 'forced' to confront, question and even reinvent their relationship with the subject (George, 2009:208).

Kendrick and McKay (2004) argued that when school practices do not afford spaces for belonging, and when students are unable to place their cherished identities that they live at home and outside of school with the new identities they encounter at school, they turn to other values and practices as forms of identification. Allexsaht-Snider and Hart (2001) also pointed out that the extent to which students feel they belong as a member of the community in the mathematics classroom is related to how deeply and completely they engage in efforts to learn mathematics, and how accessible they find the cultural patterns embedded in the classroom processes.

Presmeg (2002) added credibility to my research area by suggesting that it is necessary for students and teachers to broaden their conceptions of mathematics, as well as their beliefs, about what is entailed in the learning of mathematics. Davis and Williams (2009) put forward a very interesting point of view, one that I had never considered while balancing the fine line between student 'banter' and topic specific classroom talk, and that is that when the students talk they are being social. They argue that the open acceptance of this sociality within classroom culture is crucial to

the ways students will identify with mathematics' (Williams, 2009:145). Indeed the literature suggests that sociality might be especially important for those students whose community cultures are not well aligned with the dominant discourse of school as an institution. It would seem that ensuring that a student's personality and self-behaviours are an accepted part of doing mathematics, might be the first step to them accepting that they are 'being a maths person'.

2.7 Concluding Discussion

In a study that has characteristics that are sympathetic with my inquiry, Yackal and Cobb (1996) attempted to study and make sense, of the children's experiences in the mathematics classroom. One of their goals was to support teachers in establishing classroom environments that facilitate mathematical learning. Their initial planning set out to use a cognitive perspective to make sense of experiences in the classroom but found there was a need to broaden their interpretive stance and consider a sociological perspective on mathematical activity. They drew on constructs derived from symbolic interactionism, utilising a basic assumption of interactionism and stating that cultural and social processes are integral to mathematical activity.

A second research study that supports the view that the learning of mathematics should be viewed as social is the study by Fiona Walls (2003). She investigated a child's 'Socio-mathematical' world and from the outset, it became clear that each child in this study was immersed in a complex social environment of which mathematics learning was an integral part.

Two of my initial assumptions that have been supported during the search of related literature are that a) learning mathematics has a social nature and this needs to be considered, and b) mathematics' classrooms are unique learning environments, and as such should be treated in a unique way. Mathematics holds a prestigious position in the school curriculum, and Sfard (2009) noted that the increasing use of numbers to characterise people, to succinctly describe mathematical achievement and the use of National Curriculum levels to track achievement are indicators of this. These numbers, and by extension mathematics, are being used in everyday life as signals of a person's identity. Mathematics is increasingly seen as essential for a nation's technological advancement and mathematics qualifications are used as a gate keeper to subsequent qualifications and careers. Hence, as Gates and Vistro – Yu (2003) noted, society has imbued mathematics with significant symbolic and cultural capital, which then has implications for its position and function in the school curriculum. This domination by external assessment and numerical measurements regarding ability appears to influence the mathematical identities available to students and indeed ironically, the favourite tool of those who purport to be helping students, namely teachers, may, in fact, be one of the greatest obstacles to student learning (Gates and Vistro-Yu, 2003). In short, mathematics is used as a tool for measurement, and as such it is intrinsically woven in the process of ranking, order and value. For many it can become an object of humiliation, placing them in a position amongst others that can feel unacceptable and humiliating.

Language is a human practice; people use it to get things done. Ways of talking are considered to be social acts. In mathematics education language plays a crucial role. It is not only the vehicle with which findings are reported and the recent questions of

the field are discussed. It is also the most common resource for describing the practice of mathematics teaching and learning. Students in mathematics classrooms have to communicate with appropriate language or a system of mathematical symbols. For some, the arena in which they have to express themselves is limiting and favours those who are fairly accomplished in the use of this language and symbolic representation. In addition to this, progression in mathematics values a move from a concrete representation to an abstract representation, reducing the possibility of relating higher mathematical context to common everyday situations. These influences make mathematic classrooms unique from other classrooms. I believe that within the language constraint lies a constraint of expression, students find it more difficult to be themselves and hence perhaps feel that they do not 'fit' in that environment. This can bring additional hidden tensions to the situation. The students may make assumptions about their mathematics teacher, the mathematics teacher may make assumptions about the student, each of them based on the knowledge set that the student and teacher carry around with them. Many other subjects have more overt ways of allowing the participants to know and express themselves, through stories and writing in English, by means of movement, music and expression in drama, dance, physical education and performance subjects, and through other creative forms such as art and technology. Subjects based on the humanities and languages give opportunities to consider cultural and historical connections and developments. The constraints of the mathematical school situation induces the teacher and student to become strangers, devoid of that much needed human relationship that promotes effective learning, and I would suggest leads in some cases to the creation of negative emotions and the objectivity of mathematics as the enemy.

In this research I would like to consider the influences that students bring to mathematics lesson, and investigate how that might inform the practice of the class teacher. By investigating the students perception of the faces that mathematics presents and reviewing the influence that these views of mathematics could have on the participation in, and by association, learning of mathematics, I would like to suggest that mathematics could be presented in a more useful and aesthetic form. The development of a school mathematics curriculum that presents a 'human face' of mathematics could lead to a more equitable, exciting and accessible way for students to develop mathematical skills, logical reasoning and powerful mathematical ideas. My method for exploring the above is to consider suitable methods of communication by which students can communicate their mathematical stories. One such method suggested is through the creation of visual stories, children communicating through their drawings. Warburton (1998) explained that mediated images communicate, they are a sign system and the messages that they carry are always representative. 'Image based research is not only useful but also illuminating, engaging and stimulating' (Prosser, 1998:5).

In the next chapter I explain my reasoning for using stories as my main data collection medium and why I feel that stories can contribute to personal growth, social understandings and the formation of identities.

Chapter 3: Telling Stories

3.1 Introduction

The main form of data driving this research is stories, stories written by my students, stories told to me by adults, stories recounted by teachers including myself. The stories are about the teaching and learning of mathematics and as such, address my practice, my career and my life interest in learning about mathematics. My concern with the understanding of how 'I' (my values, experiences and culture) dictate the way I conduct my research project and interpret the data uncovered, turning it into knowledge urged me to consider why stories are the data at the heart of this research.

> Throughout the history of mankind stories have played an important part in learning at all levels, from the everyday to the sacred (Owen, 2001: ix).

This research includes two main types of story, which are fictional narratives and personal narratives. It is reported in the work of Catts et al (2003) that, as children develop, their stories tend to change from personal story types to more fictional types. This is attributed to the development of their literacy and academic skills. Stories often include events, characters and setting details. Minor events, often termed satellite events, can be omitted without any damage to the narrative but pivotal or major events are necessary (Smuts 2009). However, the essential elements of a story are the salient elements, those that stand out and grab our attention and it is indeed the salient elements of the stories produced by my students that urged me to select particular stories to highlight as research data. Although the student stories have fictional elements to them they convey a personal message to

the reader that makes reference to their individual experiences learning mathematics. Because of this, I have considered these student stories as integrated life stories which tell about a span of events over a period of time (Westby and Galatta 2016). Westby and Galatta (2016) put forward that creating personal narratives is important for social and psychological well-being, and that the generation of these types of stories stems from the author reflecting on how their characteristics have influenced past actions. The inclusion of fictional structures within these stories has been encouraged by me to help aid anonymity and to ease the difficulties associated with disclosing personal experiences. Personal disclosures can make the author feel particularly vulnerable (Behar 1996), and the inclusion of fiction can give the author somewhere to hide.

My story as a mathematics teacher, which is threaded through out this research paper, is constructed in the form of an autobiography, the telling of stories of oneself. I have the belief that autobiographical stories are powerful sources for research because they are situated, personal and poignant. Karpiak (2000) stated that the writing of autobiographies can bring a sense of order to life and help the author gain insight into their own development. The idea of autobiography as an educational research tool positions knowledge within the researcher learner. Instead of bringing in expertise from outside the research setting it capitalises on my lived autobiographical stories as a teacher of mathematics, so that I might learn about learning and teaching through telling, interpreting and problematising in my own words (Freire 1970). The credibility of the stories presented in this research is grounded in the idea of the believability of the message communicated. I was aware that the stories may not be factually accurate but felt that the message in the stories

was trustworthy. Reading the student stories elicited memories of classroom behaviours and events that I had noticed during my experiences as a teacher and they provoked thought and reflection about these various classroom situations. In addition, the credibility of my research story is related to its hearer's readiness to make sense of the text and my cultural assumptions of the way the world works, allowing them to seek familiarity in the characters and situations. Begg (2011) makes the observation that stories and autobiographies are not different from fictional stories. He explains that stories allow us to communicate multiple truths or beliefs indirectly, ones that we may find difficult to communicate directly, and therefore the quality of an autobiography cannot be judged in terms of truth. Issues of validity in qualitative research should not be linked to truth or value but should be linked instead to trustworthiness (Rolfe 2006). Rolfe (2006) goes on to point out that a study is trustworthy, if and only if, the reader of the research report judges it to be so.

Begg (2011), in support of this idea, stated that the quality criteria of autobiography should relate both the researcher and the audience, and should communicate the purpose of the research. He goes on to point out that words such as reliability and validity were developed to support the ideas of positivist frameworks and do not easily lend themselves to addressing narrative research. Begg (2011) also considers trustworthiness to be a quality criteria that could be used in this type of qualitative research but feels that the term resonance is a more useful concept, 'having the audience resonate with a story implies that the story strikes a meaningful chord, stimulates interest and connection and seems reliable' (Begg 2011:149).

3.2 The Potential of Stories

It is my belief, based on my experience, that stories can have transformational potential. By this I mean that they can transform contradictory experiences into more life enhancing experiences. Reproducing our own stories enables us to consider our thoughts and actions in a simulated environment; it allows space to replay the events and actions in a variety of ways, and the potential to create our own truths and realities. Creating through our stories a freedom of pressure from the dominating messages of existing cultures can give us room to reframe the experiences within the story and help us develop our capacity for choice. Therefore, through our creative imagination we are rewriting our fairy tales and trying out new endings with a focus on influencing personal learning.

> It can be said that stories serve as models that close the gap between my experience as a human being and the theories I can create to explain my experience. (Bateson, 1979:22)

Telling stories is therapeutic for children (Coles 1989) and can be helpful to the practitioner in providing a more empathetic learning environment in mathematics. Whiting (2000) stated that listening to children shows respect for them and acknowledges their individuality. Esmode et al (2013) found that when people tell personal stories, their observations about mathematics and about themselves are tightly connected. Using stories that focus on experiences relating to life and education is a research method that is situated within a matrix of qualitative research methods. Within this matrix I have explored the use of written data, visual data and sound data with the intention of supporting the participants in their most comfortable and productive form of communication.

3.3 Ethical Implications

There are some ethical issues surrounding storytelling that must be considered carefully when using stories as a way of collecting data. The following sections discuss the ethical issues surrounding the interpretation of story content, the truth and reliability of the story created and the inevitable relationship that occurs when a story is shared between author and reader.

3.31 Interpretation

My personal concern surrounds the issue of recording and interpreting stories accurately, both for the benefit of the participants and my audience, and these concerns led me to search for literature that would help my understanding of this storytelling methodology. I am aware that all written accounts of events are stories and the accuracy of each is debatable, and particularly dependent on who is making the judgement. A personal experience of listening to my sister recount an event that happened to us as children always brings me back to this consideration. The story she told bore little resemblance to my memories of the event, and I have no idea which of us is the more accurate as we both viewed the situation through different lenses. You might argue that perhaps it does not matter as both stories would add ‘colour’ to the event, however the reason it has always stuck in my mind is that the versions of the story are so different in their nature, one being extremely negative. The story itself is not important to me but the contrast is frightening, and highlights the role of bias in interpretation. So, I ask myself the question, how will I ensure that my interpretation of student stories is fair, honest and ethically concerned for the student in question? This question will be addressed in two ways throughout this research report. The first is the inclusion at appropriate points of my diary extracts

which is my reflexive debate constructed during the research to critique and explore my thoughts and ideas. The second way is to dedicate a section in each research phase to ethical concerns, emphasising my concern and regard for the integrity and well-being of everybody concerned in the research.

3.32 Relationship

Clandinan and Connelly (1988) made a claim that collaborative research constitutes a relationship akin to friendship. This was supported by Elbaz (1988) whose principle concern is with the story, emphasising that the collaborative nature of the research process is one in which participants see themselves as participants in the community. She feels this has value for researcher and practitioner, theory and practice. The implications tied up in this methodology and pointed out by the above researchers can potentially strengthen my research design as long as I am aware and respectful of the developing relationships. Clandinan and Connelly (1988) found that they experienced an unexpected agenda during their research:

> We found that merely listening, recording, and fostering participant story telling was both impossible and unsatisfactory. We learned that we too needed to tell our stories. Scribes we were not, story tellers and story livers we were (Clandinan and Connelly, 1988:12).

I embrace this mutual relationship and consider it to be key to improvements in the teaching and learning of mathematics, creating a new mathematics agenda that allows stories of teachers and learners to influence the curriculum, stories that hold new possibilities for all those who read them.

3.33 Are They True?

I hold some concerns about the reliability of the content of stories, however I believe that the power of the story, the intention of the author and their transformational capacity for the reader makes these creative texts a worthy data collection tool. Clough (2002) raised the question about the truth of stories and acknowledged that a single truth may not exist. My experience is that stories in general are retrospective, and as such could be said to have an element of what might be called fiction. However, I argue that the use of the word 'fiction' is inappropriate to describe the content of my research stories because to many people this can lead to understandings such as, does not exist or is not true. Bold (2012:145) replaced the word fiction with 'representative constructions'. Representative construction is based on information that is about real events. The information is reconstructed or represented in a form different from the original information while aiming to maintain the reality. This complemented Bamberg's (2006:144) definition of talk who said that 'by verbal means we relate the world to the here and now of the interactive situation'.

In this research I am exploring the voice of narrators, who are engaging in the activity of giving account, for example, when they engage in making past actions accountable for a particular purpose. It is irrelevant for the purpose of my research whether the action or happening that is accounted for, lies back in time or is something of a more immediate nature. For me, also the accuracy of the details who, when, where is less important than the fact that the narrator remembers the event and wants to communicate this to an audience. My internal debate on the strength and power of stories fuelled my reflexive voice and, coupled with the work of Clough (2002), led me to a long period of deliberation regarding the truth of stories, the

diversity of interpretation and the possible damage that can arise by taking story content too literally. I decided that if I was concerned about particular details of a story I would ask the author to clarify the situation before making any other interpretations or judgements.

3.4 Interpreting Stories

During my search for literature about storytelling, one book in particular caught my interest because of the relevance in the title, ‘Narratives and Fictions in Educational Research’ (Clough, 2002). The preface contained an extract from a poem that captured the creative thread that I wanted throughout my research and made me think about the place of interpretation in research. The poem seemed to say it all, I cannot bring the world quite round by using my ‘coloured’ instrument, but try I must.

> The man bent over his guitar,
> A shearsman of sorts. The day was green.
>
> They said, ‘You have a blue guitar,
> You do not play things as they are.’
>
> The man replied, ‘Things as they are
> Are changed upon the blue guitar.’
>
> And they said then, ‘But play, you must,
> A tune beyond us, yet ourselves,
>
> A tune upon the blue guitar
> Of things exactly as they are.’
>
> The guitarist continues:

I cannot bring a world quite round
Although I patch it as I can.
Part of ‘ The Blue Guitar’ Wallace, S. (1965:52)

This section of the poem appeals to me because it manages to be brief and yet it encapsulates the very essence of stories. The blue guitar is a symbol of the imagination. The guitar does not express reality, but instead creates a representation of reality. The poem indicates that there is a pressure from external sources to recreate reality but that this is not possible. For me, the metaphor of the guitar shares with stories, a relationship between imagination and reality, ‘things as they are’ have been changed by the imagination. Imagination is not reality but imagination through stories sets out to represent things as seen in the author’s way, not as they are, but patched as best they can.

Narratives and Fictions in Educational Research (Clough 2002), contains five differently constructed stories. The story order is important because each portrays mounting difficulty both in the content and in the experimentation with form. The first four stories are made from events that are real, made with data from interviews and observations, enriched with data from the authors own experience. The fifth story is concerned with ethics and is completely fictional, it was written in response to criticism of the author’s earlier work when presented at seminars and conferences. It emerged from response to questions asked by the audience at these events, addressing raw confrontation and what could have actually happened as a result of a story interpretation.

The book attempts to ‘trouble’ the common sense understanding of data and make available to the reader some experiments in making data. The author uses the analogy of an architect to explain the purpose of the storytelling, in the creation of a building, pointing out that the question is not - how do I construct the building? –but, what and who is the building for?

> Narrative is useful only to the extent that it opens up (to its audience) a deeper view of life in familiar contexts: it can make the familiar strange, and the strange familiar. As a means of educational report, stories can provide a means by which these truths, which cannot otherwise be told, are uncovered (Clough, 2002:8).

I found each of the five stories unsettling and yet compelling, each varied in its influence on my senses, embedded in the stories were issues of cruelty and violence, yet also empathy and understanding. They were confusing as to their point because it was dependent on the way I considered them. But the stories highlighted in the extreme one very important point – the role that the researchers own experiences play in reporting that of others. The author does not argue that all research should be reported in this way but that ‘some researchers might develop the capacity to make art if they are to fully embrace the postmodern ethnographic project in the twenty-first century’ (Clough 2002:9). The self-reflexivity within the written stories unmasks complex political and ideological agendas and this has helped me address some of the issues I have with reporting qualitative data. Clearly, I will be telling my version of the story which I have created as a result of my own interactions and institutions. A strong message from this reading is that the role of the researcher’s self plays a large part to cloud the lens, and knowledge of this begs me to ask myself, before I tell my story, a series of questions about my assumptions in the context of my research. Every researcher should ask ‘what is the story I wish to tell’ and ‘who is the audience’, and what is my purpose for telling this story?

If there is one key message that I keep from the stories written by Clough (2002), it is that if anyone is going to sit up and listen, I will need to capture their interests. In certain cases narratives would be better judged by aesthetic standards, by their emotive force, or their capacity to engage the reader emotionally in the story being told. In this case standard tests such as reliability, validity and replicability would not be as appropriate. Any report on this research will inevitably be coloured by my own interpretation but the more skilled in storytelling I am, the more accurate, anonymous and descriptive the social phenomena will be. This research account will also need to satisfy the criteria of credibility, and I hold the view that good honest writing will alert the 'senses' of the reader and relate to their own knowledge and experiences. In this way the reader will be able to judge the credibility of the findings, interpretation and the writing.

On a cautionary note, the stories of Clough (2002) highlighted another important issue. If the task of the researcher is purely one of turning up the volume on the depressed or inaudible voice, then these stories do serve their purpose. However, the last story portrayed the other side of the coin, which was the damage that a researcher can do by bringing too much of the self into the story, sometimes completely changing the phenomena in question. I agree with the author when he suggested that 'what is persuasive about a piece of research is its ability to speak to our experiences because it shares our objects' (Clough 2002:83). My stance surrounding the integrity of stories is that educational researchers should strive to incorporate within their research, an honesty and integrity of language with which to express the moral positions of the inquiry. Any research that can help us understand a context can also drive change, and for this reason I feel there is a time and place

for this type of writing. The challenge then is to conduct research and tell stories of educational settings which bear immediate relation to the truths from which they derive. The memory of my sister's version of her 'story' warns me that people are often attracted by the extreme, and this can make Clough's (2002) ideas potentially a very dangerous way of working, but ultimately courageous and effective.

3.5 Conclusion

In summary, stories provide a communication channel that allows the narrator to be flexible in their commitment to represent their experiences learning mathematics. On the one hand they can be vulnerable yet anonymous, hidden in the creation of a pseudo fictional plot, but on the other, if so wanted, they can be frank and more brutal with the portrayal of their learning situation. Between these two modes of representations are many other ways of working, yet with all is the opportunity to be playful and creative, optimistic and courageous with the plot lines and endings, creating the potential for transformation. For these reasons I am committed to the place of stories about learning mathematics as a pedagogical tool for use in my mathematics classroom. Through the medium of student stories I have gathered data about a student's mathematical life, and in addition communicated to my reader the complex subtleties that can present themselves when learning a subject such as mathematics. In the next chapter I explain my developing methodology and how it addresses my needs as a researcher who is committed to improving practice as a teacher and leader of mathematics, and promoting a positive view of school mathematics as an approachable learning medium.

Chapter 4: Methodology

Historically, in education research literature, methodology has been treated as a dichotomy between traditional positivistic research and a qualitative approach. For education, the qualitative – quantitative debate has been replaced with a recognition that each paradigm offers a way to focus on the complexities of contemporary education (Teppo, 1997). My selection of an appropriate framework was in response to the contextual needs of my research questions. At its core, research is inquiry, the attempt to answer significant questions. To form a judgement related to the research, we must know from where the researcher is coming. Pirie (1997) advises us to begin with our research question and then seek out an appropriate theoretical starting point.

I hold the belief that a great and truly important question refuses to be answered and it leads us into deeper thinking and deeper connections. Such a search can seem unmanageable while juggling the daily requirements of everyday life; we can easily ignore great questions by refusing to allocate time and energy for deeper thinking. This research is driven by my search for something compelling and worthwhile. My criteria for judging the worth of the research is, whether it advances the current knowledge in my field of interest in a significant way, which is in this case teaching and learning mathematics in secondary schools. The impetus for this research was my desire to address fundamental questions about my role in making the mathematics classroom a better place for learning.

There are a variety of research methods and they all have value in the field of research however the nature of my research dictated a qualitative approach because qualitative research involves a study of things as they exist. There is no attempt to set up an artificial situation; instead the aim is to study in depth how something is with a view to get an understanding of it. This type of approach to research was ideal for my study because it was important for me to try to create an understanding of how a student perceives daily life at my school, to gather data about their experiences and construct meanings relevant to that data.

My aim during this research was to develop a blend of methodologies that would fit a set of criteria, based on my beliefs and assumptions about how best to capture the often complex, unpredictable realities associated with learning mathematics. In addition, my methods needed to address and support my values about how people should be treated, and my personal belief that a teacher never stops learning. The research involved issues and problems that were a routine part of my day to day activity; and my aim was to gain a better understanding of these issues and problems as they arose in my everyday practice. The contribution that this research set out to offer was not only to develop understanding but to work towards changing practice. By acknowledging that the practitioner, (me), is a crucial part of the research process, I recognised that I am an insider researcher and my interactions affect the research outcomes. A model of action research was developed as my overall structure for the research. I knew at the onset of the research that my preferred way of working would fit the criteria for action research but it took me a considerable time to understand that certain principles of action research contributed to the theoretical framework for this particular research.

4.1 Action Research

I set out to use an action research process, inspired by the model of Kemmis and McTaggert (1988), to drive the related phases of the research. My aim was that my work was iterative and connected, with a reliant on practice and seeking to improve what I know and do with regard to the teaching and learning of school mathematics. What I discovered as my research progressed was that my initial plan of a systematic approach that utilised the iterative steps of an action research model, observe – describe-plan-act-reflect-evaluate- modify, began to evolve into something more complex. Instead of one big spiral moving closer to the epicentre of my research, I found that I had spirals within spirals beginning at one place of interest and taking me to another unexpected place of interest. The action research approach had the scope to address the multiple issues within my spirals while still focusing on my main area of interest, yet I found that, because of constraints on time, I had to keep reining myself in, in some cases leaving my new avenues of inquiry for another time.

It is difficult to pinpoint exactly where my action research influences originated because I feel I grew up in a world of action research, it has been prevalent throughout my teaching career, but I can name particular researchers whose words resonate with my thinking and whose ideas excite and enhance my work. I have for some time, been attracted to the thinking behind the ideas of a ‘living educational theory’ (Whitehead 1999), where practitioners generate their own personal theories of practice through studying their practice. This empowers the practitioners to have ownership of the research and utilises practitioner knowledge, which is often

accumulated over an extensive period of time. This also involves practitioners recognising and reflecting on their values and acknowledging that sometimes these have been ignored or denied in their practice. This resonated with feelings that I had experienced when I was required to wear my hat as a school manager but I felt that this position compromised my role as a mathematics teacher. I experienced feelings of frustration, knowing that in my opinion some of the decisions I was required to implement were not always in the best interest of my mathematics students. Obviously imposed decisions are carefully designed to improve aspects of teaching and learning but I felt that the imposed decisions did not always consider my students, particularly their position as caring, sensitive individuals that could be easily demoralised by the actions of the adults around them.

I now think that, as a consequence of my research developments, my interpretation of a living educational theory has evolved and deviated somewhat from my initial understanding. I now embrace a point made my McNiff (2013) that action research is not just about problem identification and solving but about realising human potential. ‘We offer descriptions and explanations for our work by producing professional narratives that show how the work improved the quality of life for others’ (McNiff 2013:35). I began to appreciate at this point that a living theory, considered as an exploration of my educational influences on my own learning and that of others, could be understood as narrative research because it is my experiences lived and told by me (Creswell, 2007). Kemmis (2009) explained that action research changes people’s practice, transforming what we do, think and say, and the ways we relate. The surprise for me during this research was that a transformation of relationships between student and teacher became a defining feature of the research outcomes

and I now consider it one of the research's most powerful findings. McNiff (2013) took the view that action research leads to the generation of a dynamic, transformational form of theory based on knowledge already located within the practitioners. Thus she explained, practitioners can generate relational forms of logic and fluid forms of thinking that allow them to recognise themselves in relation with their contexts, ' This way of knowing is embodied in the knower and their practice' (Mc Niff 2013:45).

This model of action research is a form of self-reflexive research undertaken by participants in social situations (Kemmis and Carr, 1986), and as such there exists in this action research an intrinsic connectedness between reflection and action. Luttenberg et al (2016) proposed that no action research occurs without reflection, yet this reflection, indispensable on the one hand, can potentially become a complicating factor on the other. The difficulty is the type of reflection that is required. It is a process that asks a researcher to lay bare their moral values, investigating their place in the process of the research and how they impinge on the rationality and fairness of their own educational practice. This personal honesty, scrutinising relevant shortcomings, requires a balance between uncovering what is useful to the research and what is not. However, as McNiff (2011) pointed out, moral reflection can transform practice because it reconstructs experience in the light of the values one has in life, values such as justice and equality. In addition to the problems that a personal critique of ones values can cause, McNiff (2011) also pointed out that there is a possibility that a researcher can experience problems between what is effective and efficient in a technical- instrumental sense and what they feel is morally right. This can cause political tensions in an educational setting

that need to be reconciled so that they do not influence the research process and for this reason action researchers need the capacity to act sensibly and wisely in certain situations (McNiff, 2011). The balance between political tensions and my research planning caused me long periods of deliberation before proceeding with collecting my student story data. One particular area of worry for me was the use of mathematics lesson time to allow students to create their stories. I, and the leaders in my institution, had always promoted that no time should be wasted in mathematics lessons and, in particular, that students should not miss these lessons on any other school business. My first phase of data collection was slotted in a lesson at the end of an academic term when I knew that, traditionally, little mathematics ever got done. Eventually, I recognised the importance of the stories for both mathematics students and their teacher, and that the optimum time for the storytelling workshop was near the start of the year during mathematics lesson time. The political tensions that I had felt with regard to using curriculum time for something different subsided with the knowledge that the benefits for the students sharing their stories could enhance the very area that the political tensions were trying to protect. These benefits appeared to enhance teacher/ pupil working which in turn was promoting the learning of mathematics, helping to educate our young people for life skills, further study and careers.

Before committing to an action research way of working I took some time to consider the weaknesses of this approach. A perceived problem with action research is that it is often featured in literature as a research method that is executed in the work place but does not have the credibility and support from research institutions resulting in an alleged gap between theory and practice. There is a school of thought that believes

that theorists seek to change the practice of practitioners so that they follow theorist's theories about how practice should be conducted (Kemmis, 2009). This practice of direction from external influences has been something that I have experienced during my teaching career. Kemmis (2009:468) states that in his view 'action research treats theorists as practitioners and practitioners as theorists'. By this he means that its purpose is not so much in closing the alleged gap between theory and practice, but in closing the gap between the roles of theorist and practitioner. This supported the view that action researchers generate personal theories of practice through studying their practice which, in turn, can be powerful sources of knowledge that contribute to educational research.

An action research approach had the flexibility and adaptability to allow me to incorporate into my research design common elements from a variety of research perspectives. Kemmis and Carr (1986) identified three forms of action research. The first is a technical action research which is guided by an interest in improving control over outcomes. The second is a practical action research which has a focus on educating practitioners, and the third is critical action research which has an interest in emancipating people from injustice, harm or suffering. It is common that action research has been undertaken to intervene and change practice, and as such it is driven by a critical perspective. 'In critical action research, the aim is to explore social realities in order to discover whether social or educational practices have such unsustainable consequences' (Kemmis, 2009:471). The flexibility of action research allowed me to learn as I proceeded, enabling me to develop my approach as I reflected on events and outcomes, exploring different perspectives and reflecting on associated changes in practice.

Within the action research structure I adopted the approaches of narrative research for data collection (Webster and Mertova, 2007), intuitive inquiry (Anderson, 2011) for data analysis, and symbolic interactionism to help me develop a perspective for examining data (Blumer, 1969). These approaches supported my ideas surrounding the production and analysis of appropriate data, and the search for understanding that complements the assumptions that I hold as a researcher and teacher. These perspectives were all underpinned by my desire to act in a natural way of being, with an emphasis on functioning as a humanitarian and reflexive practitioner. A growing understanding of these perspectives enabled me to develop a methodology that changed and adapted as my research work progressed.

Examining my beliefs, values and assumptions was a difficult and time-costly task as they were embedded in my day to day practice and as such had almost become invisible to me. In addition, I believe that they are not static but evolve with everything I discover as I work my way through life. My following beliefs and assumptions guided the design, execution and interpretation of this research:

For me to understand the mathematical world of school students I needed to study and make sense of that world from the perspective of the participant, and this epistemological viewpoint can be addressed by a qualitative research framework that allows the students to describe their world in a narrative form.

Students do not arrive at the mathematics classroom as empty vessels; they bring with them a range of expectations and behaviours that have been constructed

around the interpretations of events from schooling, home life, relationships, social interactions, media and their own imaginations. These expectations and behaviours are governed by their underlying beliefs and can influence their access to learning mathematics.

When students are involved in learning mathematics there are forces at play that can be invisible to an observer, instinctive to the student, and based on past histories and events.

The mathematical development of every person is equally important, it is fluid and continuous, and there is no fixed ceiling on the ability of any person (Dweck, 2000). Given these beliefs I hold the opinion that every learner should be nurtured to achieve their best potential in learning and, by association, exploring and learning mathematics.

Mathematics classrooms contain particular authoritarian, political and social agendas that make them a unique complex learning environment, and mathematics teachers can improve practice and provision for their learners by understanding and building on this unique situation.

These assumptions and beliefs that I bring to this research will influence my design of the research and my interpretation of the data produced by the students and, hence the way I use this data to formulate answers addressing my initial research questions.

4.2 A Narrative Approach

A narrative approach to my research satisfied my needs in more than one way. The first was in a methodological sense in the creation and sharing of a living theory approach to the research, and the other was in its potential as a suitable and rich data collection method in the form of stories. Cresswell (2007) claimed that not all narratives are living theories but all living theories are narratives, and that the purpose of a living theory is to explain the researcher's educational influence on learning. The most recent school improvements involving teachers have been working towards an understanding of particular actions (for example a child's test results) with reference to past actions and future potential actions (target setting and future learning). This can be described as a temporal relationship, a sequence of events in time, these events having a past, a present and a future. Temporality gives the research a future, it embraces the change process, recording and analysing, it is not just a historical moment in time; it has a future (Clandinin and Connelly, 2000). Narratives have the potential to allow the narrator to move backwards or forwards, focusing on a particular event or moment in the past and yet moving forward because they anticipate a response from an audience. This potential to manipulate the future and rewrite the past is a very powerful aspect of using narrative as a data collection method with students. It allows the potential for not only understanding the events and experiences that guide behaviour but also for communicating multiple understandings of the social world that the participant belongs to and their aspirations for the future.

To explore my student's experiences learning mathematics, I felt that I needed a research method that could incorporate the following: a) capture the complexity of human thought and behaviour; b) bring to light things that I was not aware of, c) allow a comfortable environment for the participant, and d) allow me to step back from the data generating process and act as a facilitator. Bolton (2006) viewed story making as an automatic function of our mind, and argued that producing stories is a way of making sense and organising our lives. He explained that it is a natural function for people to play and replay stories allowing story characters to experiment with scenarios and our perspectives to change.

I am by nature a story teller, I construct my stories about who I am, what I do and plan to do, I revisit and re-invent the reasons for my actions which are driven by my reflections about how I should live my life. I consider that it is natural for me to live my life through narrative, and it is this natural process that I would like to capture in my research methodology. It is through our stories that we can actually profess what we believe, and through the stories of others we hear what they profess to believe. My stories get me closer to knowing who I am, and hearing my student stories gives me an insight into who they are. Geelan (2003) described the activity of research as an activity of imposing order on the chaotic contexts of life experience in order to be able to talk about them. The stories of students are likely to be less ordered and understood than those of an adult, but I believe will be no less rich and complex. Eisner (1998) argued that in a sense all inquiry into the world is qualitative: it attends to the qualities of things – behaviour, experience, performance etc. Therefore, a research method that involves written or spoken language can supply data that has the potential to reveal innermost thoughts, frames of reference, reactions to

situations, and cultural conventions and as such, can be considered to be qualitative. Webster and Mertova (2007) claimed that using narrative inquiry as a research method can provide researchers with a rich framework allowing them to investigate the ways humans experience the world.

My initial interest in narrative as a methodology was in its value as a data collection method. I considered it a useful way of collecting the type of qualitative data that I needed to address my research interest. However, a deeper understanding of narrative research furnished by wider reading has convinced me that narrative can address both the phenomenon and the method, this was an idea explored in Clandinin and Connelly (1990).

4.21 Narrative as a Method

Narrative can be used in the research process as a way of collecting data and making meaning, using common narrative structures and characteristics. As a data collection method I chose to describe narratives as oral, written or visual accounts of events told to others or oneself. In particular I was interested in narratives that refer to accounts of personal experience, or the experience of others. These may include accounts that appear to be fictional, but not ones that are purely descriptive lists of mathematical topics or disconnected or abstract productions.

4.22 Narrative as a Phenomenon

In this research the narrative as a phenomenon is to be found in my personal story which will thread throughout this research. This is called ‘my diary extracts’ and will

communicate to you my journey in the form of a Scholarly Personal Narrative (Nash 2004).

The key to narrative as a phenomenon lies in the fact that narratives are simultaneously created and furnished by the individual to model the world. Our narratives are influenced by our culture and experiences, 'Religion, ideology, legends, fairy tales, folk lore, the education system and academic disciplines supply ready-made models of the world' (Chafe, 1990). Nash (2004:2) identified himself as an advocate of the power of personal narratives. 'I have found that personal narrative writing helps us to understand our histories, shape our destinies, develop our moral imaginations, and give us something truly worth living for.' Gudmundsdottir (1996:298) gave some insight into the transformational value of narrative. 'Narrating an event for the first time affects how people subsequently remember and retell the event. In re-telling, the narrative can change, and people no longer have access to the original image.' Nash (2004) considered that exploring our narratives could lead to transition and self- empowerment. This resonated with my understanding of narrative as a phenomenon, and I am interested in the construction of stories because I believe that these stories can create a deeper understanding about the mismatch between personal expectations and institutional ones.

So what exactly do I consider to be narrative? Narratives are the stories we live by. Every life has meaning both for the person and others. Narrating is about expressing your voice, in your own language, with your own version of your own story, in your own manner. My interest in narratives has two dimensions; the first is my belief that

narratives tell the events of human lives, it reflects human interest and supports our sense making process (Bold, 2012:21). Narrative have implications for our view of the learner (Webster and Mertova, 2007:16), ‘a concern for the narrative brings to the forefront features of the learners thinking and learning needs that may have been neglected through more traditional research methods.’ The second is my tacit understanding that most people find that communicating through a medium such as narrative can be unobtrusive, creative and satisfying. Clough (2002) and Bolton (2006) did not try to define narrative as having a particular structure but focused on the meaning that stories hold for us individually and collectively. This echoed the essence of my research, which was exploring the mathematical stories told by my students. I did this with a view to understand more about my student’s experiences learning mathematics and hence, learn more about my practice towards those individual students, enhancing my understanding of their experiences through the meaning that story has for me. I felt that this exploration could provide data to address my initial research questions and some of my sub-questions.

The participants in this research were secondary school students between the ages of 13 and 16 years old. They were all girls and they were all students at my place of work and at the time of their story telling workshop I was their mathematics teacher. The students had different mathematical abilities and there is more detail regarding their specific mathematical levels and grades in the following sections of the research. In addition, two experienced teachers of mathematics, both who were colleagues of mine, trialled the story telling workshop with their own mathematics classes.

My research was driven by the belief that my students wanted to be understood and to be heard. A methodology that allowed them to share their personal stories provided data to furnish my understanding of the complexities involved in learning mathematics. Yet possibly more importantly it gave my students a forum to be heard, a forum to construct 'their truth', to penetrate the impersonal shield that often sits between student and teacher, student and student.

I began to appreciate the role of narrative as a phenomenon during the pilot phase of my research, during my reading the first set of student stories. Once a story was read, my perception of that student altered dramatically. Reading their story ambushed me with a mixture of emotions and I experienced an unexpected empathy about my encounters with that student. My head began to fill with thoughts regarding prior mathematics lessons and plans for their future learning. Through this phenomenon I began to appreciate the place of narrative in shaping who we are and what we do. Nash (2004) discussed this shaping of ourselves as a constructivist circle explaining that the stories we construct then turn around and construct us forever. A narrative influence in my research worked for me on a personal level. I find that student work, in the form of a story, captured my interest, gave me knowledge to reflect on and allowed me to build a profile of my student and their personal needs in the mathematics classroom. These needs are not the things that I can assess by just seeing their mathematics alone. For me, the vast numbers of students I teach can feel overwhelming, I struggle to get to know them quickly and well enough, so that I can teach them uniquely and effectively. I know that for some teachers, a coping strategy can be to treat the students as objects, faceless and mechanical, adopting a 'one size fits all' strategy. In this strategy students are all

treated in a uniform manner, taught and assessed as a uniform group and then ranked according to their performance in this uniform world. For many students this model of learning mathematics leaves them hopelessly stranded and unsure of how to move forward. This mechanical model of treating students as uniform receptacles is something that I often reflect on. If everybody has unique experiences, their own unique way of learning and a particular unique identity, then surely they need to be appreciated as unique individuals. But, how can a mathematics teacher appreciate the contour and detail of each student?

My own practice has taught me that, over a period of time, I develop a deeper understanding about many of my students, and this process highlights for me distinctive features about them that has enabled me to teach them more effectively. I have always felt concerned about the length of time this process can take and that some students can stay featureless for a long period of time. If a student has no defining features to me, then my relationship with them is weak and I am concerned that, for them, my teaching is lacking. I was convinced that to improve my teaching of mathematics to any particular student I needed to understand the context within which they worked and the mathematics story they carried every day into my classroom.

A child's learning and subsequent achievement has to be set in the context of home and school, their relationship with adults and peers, and with home and school systems. Understanding how individuals are affected by different contextual influences is an essential ingredient to help teachers provide the most appropriate

support for the child's learning. My reading and personal experience has convinced me that a narrative approach captures contextual influences in a way that other research methods may not.

Smith (2000) explained that narratives are regarded as a basic and universal mode of verbal expression. Telling about past events is one of the earliest forms of children's discourse. My personal experience as a mother, friend, colleague and child, helped me understand and appreciate this point made by Smith (2000). My interactions with people provided me with evidence to support the belief that in everyday conversations we recount experiences or tell stories to inform, instruct, entertain, impress, empower or exonerate. Advocates of narrative believe, as do I, that they can yield information that may be difficult to obtain by another method; this could be information that is sensitive to the informant, or that it is at the back of their mind, forgotten or purposely filed away. In contrast, Bamberg (2006) argued that narratives do not give access to the speaker's past experiences nor their reflections on their past experiences. Rather, he feels that through the narrative we study **talk**, and in and through this talk we establish what the talk is about and particular social interactions in the form of social relationships. This view of narrative is what I believe drives the phenomenon of narrative; through narratives we explore, placing ourselves in learning situations that are not exactly accurate but are reflections and transformations of a reality. Narratives cannot be simply taken and interpreted for what has been said. They have to be analysed and the analysis has to work with what the reader already understands about the world. This is particularly where a narrative written by my student worked for me, the information contained in the narrative blended with, and enhanced my thinking and reflection about the student.

In this way I was a reacting human being, learning and expanding both my understanding of the student world of learning mathematics, and myself as a teacher of mathematics and carer of the students in my classroom. For the listener, narratives can raise consciousness, create a shared history and a shared group identity, and preserve and transmit culture (Smith, 2000: 329).

Kress and Leeuwen (1996) highlighted the disjunction that occurs between the context of production and the context of reception. The text (story) is written for a model reader, determined by the author, and thus the validity of that text is dependent on the shared understandings of various contexts that exist between reader and author. This element of shared understanding is constrained by differences of age, position and power, culture, social class and past experiences. Due to my role as a mathematics teacher, and my experience as a school student, I felt that I had a shared understanding of some of the context in the student stories. This understanding was limited by my position and age, but I viewed the process of analysing student stories, and particularly aspects of my personal reflexivity, as a learning opportunity for me to build on my understanding. For me then, the accuracy of an account is a complex issue and was not a particular focus in my research. The need for the student to recount a particular story, and my developing understanding of the place this story has in the student world of learning mathematics, provided knowledge that had the potential to increase my understanding of the learning situation. My scrutiny of the stories focused on two main areas. One was the relationship between events pertaining to the learning of mathematics, and the subsequent experiences and behaviour of students. This gave me the opportunity to address my first research question, asking if learning mathematics is an

uncomfortable memory for some students and if so, why that is. The other focus was on the influence that student mathematical stories have on their mathematics teacher and how this informs subsequent actions. By doing this, I hoped to address my second question and look at developing and improving approachable and effective ways of working between mathematics students and their teacher.

4.23 Issues of Safe Guarding

Narrative research of the kind I was planning required a trust relationship between the researcher and the participant. This kind of research can make the researcher and the storyteller particularly vulnerable. After each workshop there was time built in for students to talk either in private or in groups to discuss their experiences encountered during the process. In all planning and subsequent reflections, where there may be emotional or delicate issues I adopted a collaborative approach to my critical reflections. Discussions with my supervisors, and informed school colleagues helped me deal appropriately with sensitive issues. I had a safeguarding step in my planning which was that, in the event of problems, I would seek out a more experienced researcher who is experienced with narrative research and who could give me advice with my planning and analysis.

4.3 Intuitive Inquiry

Intuitive inquiry is a methodology that addresses my need to embrace the following in my research design. The first is the transformative nature of my research experience; the second is recognition of my years of experience as a teacher; the third is the preservation of student voice and the fourth is an investigation of the use of an imaginal dialogue between student story and teacher. Throughout the progress

of the research I began to understand that, by responding to the student stories, I had developed and changed my understanding of my role as a teacher of mathematics. Moustakas (1990) explained that the growth and learning of the researcher can be as important as the conclusion in a transpersonal research. Intuitive inquiry was developed by Rosemary Anderson in 1996 as a transpersonal research method that invites both intuition and embodied writing into the research process. This approach presented by Rosemary Anderson (2011) formally specified methods that incorporated the researchers' intuitive, emotional, and personal capacities, and my particular interest in this method is in the development of intuitive inquiry into a multi-method approach to research allowing methodological inventiveness (Dadds and Hart, 2001), and flexibility.

This intuitive inquiry approach was adopted in the research work of May (2006) because it has the capacity to accurately relay the richness and complexity of the creative process. It is a way of looking at the world which finds room for revealing what it means to be human, allowing a reflexive way of working to underpin values and assumptions. Intuitive inquiry often applies elements of hermeneutics to qualitative analysis, which is an approach that is focused on the understanding and interpretation of texts, particularly with an emphasis on the meaning of the text from the perspective of the author (Bryman, 2008). Yet, it is possible to integrate and adapt its procedures with other analytical approaches to research (Anderson, 2011). Interpretation, in the case of intuitive inquiry, is understood to be 'self-reflective, iterative and ongoing, with the interpreter mindful that his or her pre-understandings influence the interpretations' (Anderson, 2011).

A key focus in an intuitive inquiry model proposed by Anderson (2011) was the role of intuition in the researcher's interpretation of the findings, and therefore it was important for the purpose of this research for me to define my personal understanding of intuition. Some of the definitions readily available through a quick internet search appear to portray intuition as unintellectual and based on guesswork. Wikipedia.org (accessed on 14/9/2015) stated that intuition is a phenomenon of the mind described as the ability to acquire knowledge without inference or the use of reason and Encarta English dictionary described intuition as distinctive knowledge, the state of being aware of knowing something without having to discover or perceive it. Both these definitions make intuition sound like an apparition that is based on nothing factual or concrete, yet I believe that most people would concede that intuition is based on gut feelings and ideas formed from our past experiences and knowledge. So, I argue here that my past experiences and histories act as information receptacles from which I intuitively draw knowledge every time I engage with my students and their stories. Firstly, I have taught mathematics for more than forty years, so aspects of the imaging and emotions portrayed in my student stories are ones that I am familiar with. Secondly, I have been a student of mathematics, in a state school, and in that capacity I have experienced failure and success, excitement and disappointment, and the important sense of belonging and feeling excluded. Finally, I have been a child with all the cultural expectations imposed by parents, including feeling misunderstood and out of place.

My working definition of intuitive inquiry blends a mix of empathy with staying attuned and aware of my emotions and reflexive debate. Empathy is the intellectual identification with the thoughts, feelings and attitudes of my students through

engaging with their story. Staying attuned and aware of my emotions is the discipline of considering affect as a reaction to my student stories and the ongoing consideration of teacher /student relationships prior to and after the storytelling. Reflexive debate is the conversation I have with myself with regard to my values, my biases and my shortcomings when responding to my first reading of student stories, my analysis of these stories and my critique of my interactions with the author of each story. Reflexive debate could be thought of as my inner voice speaking to my conscious, trying to make sense of an action or an event. This debate allows me to play out privately the causation of my student's feelings and actions, and gives me a forum to try out alternative points of view. It also encourages me to question my choice of research, and my reasons for this research, examining my wounds and the degree of personal that is appropriate for me and my research participants (Anderson, 2011). Anderson (2006:10), speaking of the intuitive inquiry processes stated that, 'sometimes the processes and insights are strictly personal, and sometimes they shed light directly on the topic of inquiry, or both'. What I have described as a reflexive debate, one that tugs at my consciousness willing me to stay honest to myself and my students, with soul in mind, is my interpretation of what Anderson (2011) referred to as an imaginal dialogue.

To validate my understanding of intuition and use of intuitive inquiry for this research, I will draw on the work of Anderson (2011), and select from her typology of intuitive modes two that resonate strongly with my particular understanding of intuition. The first is termed 'empathetic identification' (Anderson, 2011:248), which she describes as a form of compassionate knowing or empathetic identification which allows us to inhibit the lived world of another person or object. The second she terms as 'through

our wounds' (Anderson, 2011:248), by which she means that 'a researcher's intuitive style tends to settle among the fault lines or wounds in the researchers personality'. I have interpreted this as an internal feeling that all is not well, either with my identity as a teacher of mathematics or within the culture of mathematics that I am expected to function in. This description planted the seed that encouraged me to examine my thoughts regarding the complex relationship between me, the researcher and the topic being researched. Anderson (2006:8) explained that from a spiritual perspective, our wounds can be seen as openings to the world and explorations along these lines often 'invite change and transform these openings'.

Through the work of Romanyshyn (2007), I began to appreciate that the research topic had chosen me perhaps even more than I had chosen it. Out of all the possible topics linked with mathematics that I could have researched, I entered into a research endeavour that I find difficult to describe, give name to, and give it justice when writing this report. This mode of intuition begs me to dig deep inside my consciousness, asking myself exactly why this research is so important to me, what are the wounds and scars that sit in the middle ground between intellect and sense. Romanyshyn (2007:81), influenced by the work of Jung, described a region of reality that is intermediate between sense and intellect, mediating between them. 'This intermediate world is the world of the soul, which has its own ontological status as a domain of reality between the domains of matter and mind'.

Romanyshyn (2007) discussed the idea that feelings of loss and failure can come from research that keeps soul in mind, that is re-search, a searching again for

something that has already made its claim upon us, something we have already known, however dimly, but have forgotten it. ‘The struggle to recover what has been lost and found again, is the struggle in the gap between what is said, and what wants and needs to be spoken’ (Romanyshyan, 2007:4). The awareness of the gap between language and experience brings about a sense of sadness, a feeling of mourning for what is lost. ‘The mourning that attaches itself to our knowing has a sweetly bitter quality that comes from yearning for something that, while never attained, is always with us’ (Romanyshyn, 2007:5). Throughout this work, Romanyshyn (2007) made a case for, and presented research that would keep soul in mind. This is not the concept of soul that I was indoctrinated with at an early age by my parents and schooling. Romanyshyn (2007) described soul as our circumstances and vocation, it is not inside us, it surrounds us like a type of epiphany that calls us into our work. ‘But how do we give voice to such moments, and how do we re-search those moments in our work when the soul of the work shines through the idea, the theory, the fact and the data collected’ (Romanyshyn 2007:7).

4.31 Description of the Intuitive Inquiry Method

Intuitive inquiry describes an investigation based primarily on intuition rather than analytical or rational processes. It starts with the researcher identifying their values and assumptions and then using these as a lens to begin interpretive cycles of analysis. Anderson’s model of intuitive inquiry was composed of five iterative cycles of interpretation.

Firstly, the researcher selects a text or image that is related to an area of personal interest that repeatedly attracts their attention. The researcher then engages with the text or image on a regular basis recording both objective and subjective thoughts, impressions, intuitions, observations, daydreams and conversations.

Secondly, the researcher reflects upon their understanding of the topic in light of available literature about the topic, and prepares a list of interpretive lenses that express the researcher's understanding of the topic, often developed simultaneously with the literature review.

Thirdly, the researcher identifies the best source of data for the research topic, identifies criteria for selection of research informants and collects the data. 'Since intuitive inquiry invites an in-depth process, one should choose the data sources that identify their passion as researchers' (Xenitidou and Gilbert, 2009:52).

The fourth step is to interpret the data in order to modify, refute, re-organise and expand their knowledge of the topic. This stage allows the researcher to refine their pre-understandings of the topic by engaging with the data, organising and reorganising the data, recording both subjective and objective data, blending a variety of analyses strategies and techniques. Throughout the process, an important feature of intuitive inquiry is intuitive breakthroughs, illuminating moments when the data begins to take shape, revealing patterns and insights with each fresh set of information. In this process both observational data and intuition are encouraged as sources of amplification and refinement of one another.

Finally in step five, the researcher stands back from the data and considers all aspects of the study with a fresh look.

4.32 Limitations and Shortcomings of the Intuitive Inquiry Approach

In my review of the literature surrounding the topic of intuition as a qualitative method for interpreting data I have found that it is hard to understand how the intuitive researcher has arrived at their conclusions or how firmly they are grounded.

Using intuition and reflexive practice is a very personal and private process. A difficulty is finding the balance between the information that is a necessary part of the research to help the reader understand the interpretations and intuitive breakthroughs of the researcher, and information that just is included as the researcher's voice.

4.4 Portraiture

Discovering portraiture empowered me to proceed with my research in a way that supported my urge to be creative. It helped liberate me from my inhibition that I could not find my unique voice in a world that communicated through esoteric academic language. I also felt that the ideas behind portraiture addressed my desire to communicate to a wide and varied audience, the stakeholders concerned with learning school mathematics. These stakeholders consist of university academics, school leaders and governors, teachers and teaching assistants, parents and guardians and mathematic students. Portraiture encourages a language that is understandable, not exclusive and expert, with an aim to expand the audience and welcome more voices (Lawrence-Lightfoot, 2005).

Portraiture describes the actions of the research as voice. Lawrence-Lightfoot and Hoffman-Davis (1997) explained that the portraitist voice is everywhere and there is no part of the research that goes untouched by some aspect of the researcher's voice. This approach acknowledges that researchers are often attracted to a project because of personal interests and prior experiences (Hackmann, 2010). As a result, rather than aiming for objectivity and detachment, the researcher's voice is woven into the written document called a portrait, which is created as a result of the researcher's interaction with the research participants. Intertwining the researcher's personal context into the research text is intended to enhance the understanding of the research subject and encourage a level of understanding and empathy that I feel would be difficult to achieve if I were writing as a detached observer.

As a research strategy, Lawrence-Lightfoot and Hoffman-Davis (1997) explained that portraits are designed to capture the richness, complexity and dimensionality of human experiences in a social and cultural context. They aim to communicate the perspectives of those people who are negotiating these human experiences. In the process of creating portraits we enter the lives of people, build relationships and engage in discourse.

My aim for this research was to try to create life images of learning mathematics in school and trace connections between individual personality and culture. The aim with portraiture is to create a document that comes as close as possible to painting the subject with words yet knowing that an exact image of the subject is not

achievable. Lawrence-Lightfoot (2005) explained that the portraits are designed to capture the essence, qualities of character and history of the subject. The translation is probing, layered, and interpretive, while always being watchful of feelings, perspective and experience.

In using the methods of portraiture I acknowledge that I want my research participants to feel seen, appreciated and respected. By creating opportunity for dialogue this methodology engages in implicit and explicit acts of social transformation. Portraiture cannot tell you what you should do when faced with an educational problem but what it can do is help you think more intelligently about that problem (Hackmann, 2010). Laurence–Lightfoot (1983) suggested that a research portrait can be used to stimulate change within individuals and organisations because enhanced understandings, (thinking more intelligently), brings with it the possibility of change.

I found that the methodology of portraiture offered a different way of thinking about generalisation than many other forms of research. Rather than reducing the data by seeking patterns and themes and using a codified method to connect them, portraiture seeks to illuminate the complexity and detail of a particular experience hoping that the reader will see their lives and experience reflected in it and therefore feel identified. Lawrence-Lightfoot (2005) stated that rather than looking for a universal truth the reader will discover resonant universal themes. This difference in perspective of generalisation became important towards the latter stages of this research when I had exhausted my work looking for themes and had started to feel

that I had lost the authors voice in translation. I began to appreciate the point made by Lawrence-Lightfoot (2005) which was that two powerful characteristics of portraiture were its ability to embrace contradiction, and its ability to document the beauty and the ugly of experience, both of these being very much a part of human development and social relationship.

Once committed to the place of portraiture in my methodology, I felt that the research was potentially empowering, both to the teacher and to the student. Empowering to me because it gave me an opportunity to reflect, (both beauty and ugly), on my work, goals and values. Empowering to the student because it gave them a voice so that they could make known their opinions and experiences about learning mathematics.

4.5 Symbolic Interactionism

I was introduced to the ideas of symbolic interactionism while I was searching for research that had something in common with my own. The research of Wall (2003) and Pollard and Filer (1999) were both interested in the experiences of school children as they negotiated their way through school life. Both studies adopted an approach that utilised the ideas of symbolic interactionism as a way to conduct their research and look at the subsequent data. Symbolic interactionism complimented the view that learning mathematics is a social act, and hence worked well with my approach to researching this concept. Blumer (1969) explained that with this perspective, groups such as societies and cultures, exist through the meanings that arise out of social interaction and for this reason should be viewed through action. By action he was referring to activities that individuals perform in their lives as they

encounter one another and deal with everyday situations. Learning mathematics is one of these social acts, containing classroom practices that operate within the regimes of truth, knowledge and power. I decided to use a symbolic interactionist approach to guide the framework for analysing student stories about mathematical experiences because it focused on the creation of meaning as people interact together in both verbal and non-verbal communication. I feel that symbolic interactionism would prove extremely useful as a framework for the data collection stages of my research because while it recognised the individuality and therefore uniqueness of each person, (in this case the students learning mathematics), it also acknowledged the importance of social interactions with family, peers, teachers and environmental objects such (books, teachers, classrooms and work), with which, between which and within which each individual negotiated personal meanings through interactions with others (Walls, 2003). There is evidence in the research of Walls (2003), Yackal (2000), Reay and Wiliam (1999) and Winbourne (1999) that symbolic interactionism is a useful approach for educational research that attempts to see and describe the taken for granted, ordinary and routine in the everyday mathematical world of the child. This is because it attempts to probe into the hiddenness of the structures and processes that generate their mathematical world encouraging a sociological attitude by which to uncover and make strange the features of a child's social world of learning mathematics.

4.6 Conclusion

Within this overall methodological framework, I found my ideas and thoughts developing in various directions and my research became visible to me through my literature reading. My need for methodological inventiveness (Dadds and Hart, 2001), became a key feature of the research design. I found that I began to develop

my own unique way of working through the research and then trying to put that way of working into a form that would identify with known methodological approaches. This became a struggle because my research contained aspects of many approaches and the comparison between my way of working and the details of each approach identified in the literature were often tenuous.

I began to appreciate that it was important for my motivation and drive that I had ownership of my methodology, and that it served the purpose that it had been developed for, which was to educate my practice relevant to the daily experiences of the mathematics learners in my care. Dadds and Hart (2001) pointed out that it is important that the methodological approach should match the message that the researcher seeks to communicate, and that equally as important, is the willingness and courage that practitioners show when creating an inquiry approach that enables new valid understandings to develop. I placed importance on the purpose of my practice that could be served by this research, and the integrity and method by which I made my methodological choices. Dadds and Hart (2001:169) felt that if professional intention informed the research then the methodology 'should not be cast in stone'. In the next chapter I give a brief overview of the contents of the four data collection phases. I then give an account of the first phase of my action research process and the data outcomes that were produced during this period.

Chapter 5: Action Research Phases One, Two and Three

5.1 Introduction

My action research progressed naturally through four phases. Phase 1 was a pilot phase to test the water for a storytelling data collection method. It was designed to address two research questions which were firstly, would students be happy to share their stories about learning mathematics and then secondly, would the stories contain rich data that would help develop my research further? Phase 2 built on the lessons learnt in phase 1, but the sample of students was a purposive sample selected on the basis that these students had experienced struggle to achieve their school target in mathematics. In addition the storytelling workshop was trialled by two colleagues. Phase 3 added a new dimension to the storytelling workshop because it focused on the timing of the workshop and the subsequent developing relationship between teacher and student. The last phase was a period that included my analysis, reflexive contributions related to my teaching practice and much reading and thinking about the student stories. An overview of each phase of the action research is described in the table below.

Figure 2 Action Research Table

Phase 1 Pilot Study		
Aims: To trial a storytelling workshop. Questions: Would the students share their stories about learning mathematics? Do student stories provide rich data?	Data collection method: Student stories Reflexive diary Observation	Outcomes and recommendations: Students were keen to share stories and the stories were rich forms of data. Reduce influence of teacher in future story telling workshop. Ask for individual stories. Allow more time for workshop plus include designated feedback time. Build on what has been achieved re data analysis.

Phase 2 Storytelling workshop		
Aims: To try the story telling workshops with different students. Colleagues trial the storytelling workshop in their classrooms. Include student feedback in the form of audio recordings and interview.	Data collection methods: Student stories created as text, poem, song, poster and picture board. Reflexive diary. Student audio recording about their story. Student interview about the story telling process. Classroom observation Discussion with colleagues	Outcomes and recommendations: The timing of the storytelling workshop, should it be earlier in the academic year? Consider why some stories have a bigger impact on me than others. Consider the impact the stories have on subsequent teaching and learning. Include a second story later in the year to investigate student transformation.

Phase 3 My special groups		
Aim: To run the storytelling workshop early in the academic year. To investigate which stories have the most impact on me and why. To explicitly consider changes to my practice post stories. To repeat the storytelling worshop later in the academic year.	**Data collection method:** Student stories created as text, poem, song, poster and picture board. Reflexive diary. Classroom observations. Pupil progress through out the year.	**Outcomes and recommendations:** Student stories had a profound effect on my relationship with the participant and my subsequent teaching of that student. The analysis of the stories takes place from the very first reading and cannot be separated as a particular section of the research. The data suggests that stories gives the student voice, power and an understanding of themselves and their relationship with mathematics.

Final phase used to draw together ideas and form a data analysis		
Aim: To draw together ideas and develop an analysis model. To utilise and develop an intuitive inquiry analysis method that could preserve student voice, teacher intuition and empathy, while incorporating rigour by using thematic analysis and peer validation. To develop a style of personal writing that opens a window for readers to see and recognise aspects of their own world view.	**Method:** Revisit diary extracts and notes about ideas, thoughts, intuitions and imaginings stimulated by the student stories and my classroom practice. Carry out a thematic analysis to help support or refute other data analysis.	**Outcome and recommendations:** An intuitive inquiry model that complements my research. Specific story themes that inform what I look at during the data analysis. A critique of my classroom practice and the development of a way of working that allowed student voice and preparation by the teacher for the individuality of the students that they teach.

5.2 Phase 1 Pilot Study

The purpose of my pilot study was to trial a data collection method that was unfamiliar to my style of working. This was a data collection method that was based on communicating experiences through the medium of storytelling. Coming from a mathematical background, I felt more comfortable with data that could be measured or counted and less familiar with data collected through written methods. However, I was convinced that stories would suit the purpose of my research and therefore was a better way to proceed. The ideas behind this data collection method had largely been informed from my day to day experiences in the classroom, watching how expressive and creative students can be when allowed to explore ideas in ways that suited their imagination. The topic of the data collection was in response to a concern that I had developed over many years which was, that while many students have positive attitudes to learning mathematics at a very young age, there seemed to be a large proportion of students that lost interest in the subject as they progressed through their school years. It was found that this loss of interest could be associated with a related decline in their achievement (Walls, 2003; Boaler, 1999). A question that I hope to provide some insight into is one that was previously posed by Walls (2009) which is, what is it about people's experiences of mathematics that brings about such a strong sense of alienation?

My focus for the pilot was centred on pedagogy, and in particular the aspect of expression and communication. I have always been intrigued when a student communicates his or her thoughts and ideas in a novel way, and the challenge for me was to allow time to understand, nurture and steer this creative aspect of

communication in a direction that would both stimulate the student and meet the needs of my inquiry. My experience as a mathematics teacher had made me aware that students were often drilled in the use of appropriate mathematical language and formal methods of working (Nardi and Steward, 2001; Boaler, 1999). When students have to communicate with mathematics or a system of mathematical symbols, this can become, for some, a very limiting arena in which to express themselves, and to feel comfortable they need to be fairly accomplished in the language field and symbolic representation of mathematics. I suspect that as a result of this, some students can become mute (in the mathematical sense), and this research places an important emphasis on the acceptance that individual, unique expression about personal mathematical experiences is a necessary and liberating part of mathematics education. With this in mind I was drawn to using a storytelling workshop as my tool for a pilot investigation.

The action research model that I have described above supports the place of narrative both as a method and as a phenomenon, using stories as a communication channel to collect data and also to create a tool to navigate past and present actions and their subsequent consequences. My research narratives contained descriptive accounts of doing the research, as well as explanations of why the research was being undertaken and what the researcher hoped to achieve.

5.21 Methods for Phase One

The data collection tools that I chose to use in this research are listed below with a rationale for their choice. Throughout the research I placed an emphasis on flexibility and creativity and the methods adopted were chosen to support this approach.

The main form of data collection was a storytelling workshop where students created their own stories about their experiences learning school mathematics, which for the purpose of this research, was viewed as their mathematical world. The data produced during this research method was predominantly qualitative although during the analysis I made use of a small amount of quantitative data.

My second data collection tool was a reflexive diary which I have named ‘my diary extracts’. It was important to me that an attempt to improve practice should be grounded in a process of constant reflection on that practice. An assumption and belief underpinning the whole of this research process is that deep critical reflection has transformational potential. In the busy day to day bustle of fulfilling the role of school teacher and researcher it is very easy to commit things to memory only to find that on recall the essence is lost. The discipline of recording thoughts, actions, ideas and observations on a daily basis seemed essential to the research process, and yet this routine is one that I struggled with. To facilitate this process I tried to keep in mind three principle questions: Why have I chosen to do this? How is it going, and what have I found out or learnt? With these questions in mind I kept a reflexive eye on my progress which then helped me make informed decisions about the research and when I needed to change direction.

My third data collection tool was observational field notes. These observations were useful because they gave me the opportunity of studying students in their mathematical learning environment, and by planning and recording systematically they became a research tool that could provide accurate descriptions of situations,

and equip me with data for further investigation. The limitations of these observations were that it was difficult to record detail quickly and it was not possible to go back and check my observations later, hence validity and bias was possibly compromised by my interpretations. Extra care needed to be taken when interpreting my findings because the kind of knowledge created by observable situations was inevitably influenced by the assumptions I brought to bear on the situation. To address this difficult situation I set out to use a process of triangulation to collaborate my findings. This process included observing as many events as possible, drawing on the tacit knowledge collected over my teaching career, discussing interpretations with colleagues, and using a reflexive debate as explained in my methodology to critically review my findings and gather alternative perspectives. The data collected was qualitative, describing behaviours, body language and the engagement of groups of students in a variety of school mathematics lessons. My hope was to capture a moment in time of the social world of a child in a school setting, recording behaviours that could highlight the invisible influences that can be brought to various school situations. This data was available and abundant during my day to day practice and gave me an opportunity to record what was happening in the class and reflect and challenge my assumptions.

The final form of data collection for this phase was discussions with teacher colleagues, researcher colleagues and likeminded people. I respect and value the place of collaboration in my research because collaboration brings a body of individual and shared knowledge to the project, gives opportunities to validate work and conclusions, and brings me back to earth in a reflective way.

5.22 Organisation of the Pilot Workshop

I had been thinking about using student stories as a form of data collection for some time but I was not sure how the students might respond to this. The idea was inspired by watching children interact while supervising a school trip. I had been asked to accompany a group of students on a retreat organised by the religious education department. The group I was asked to accompany was a group of 13 year old students that I knew well. Some of the group had a history of being badly behaved and disrespectful to other adults and I was not particular confident that they would embrace the ethos of a religious retreat. However to my surprise, they were asked to make a puppet and then give their puppet a name and a story, and their contributions made me sit up in wonder and respect. They happily took part in the process and I learnt more about the students through their puppets than I thought was actually possible. This experience gave me the inspiration and the confidence that a story telling workshop could be a very good way to collect data about learning mathematics.

While considering the best way to introduce a session that would give the students a vehicle to tell their personal mathematical story, I pondered on the idea of giving them an example of my mathematical story or an anonymous mathematical story. However, I decided not to because I was worried about introducing bias through my version of mathematics, giving them too much insight into what mathematics might mean to me. So instead, as a starting point, I designed an introduction sheet that would introduce the task in a simple way, hoping to pitch the proposal well enough to elicit enthusiasm. My year nine class had just finished a project that had lasted several lessons and we had one lesson spare, it was an afternoon lesson, the last

mathematics lesson that week for this group. I had wanted to try out the idea of developing student voice with this particular group and the timing seemed the ideal opportunity to try something very different.

The selection of this year nine group as my participants was important to me, it was based on convenience because I was their teacher and also because I was particularly interested in their behaviour with their previous mathematics teachers. They had experienced a very troublesome mathematics education during the previous year, starting with a teacher/student relationship that proved to be inharmonious, and culminating with a stream of short term supply teachers with the result that their mathematical experiences and learning was erratic and discontinuous. The class appeared to be very angry, displaying difficult behaviour towards their mathematics teachers, and had been very vocal about their feelings towards particular teachers. This year the class had settled well, their behaviour, although often cheeky, was generally well mannered. They were in general enthusiastic about their mathematics lessons and I found them very interesting to teach. The class range of mathematical abilities, according to school data (based on prior data from Key Stage two), was focused towards the top end of the National Curriculum spectrum. My own assessment of their range of mathematical abilities also placed them towards the higher end of the cognitive continuum but I had concerns about their confidence and how they applied themselves to new or more challenging concepts. The realities in the classroom was that formal mathematical attainment appeared to vary across the National Curriculum levels depending on the mode of assessment, with test results deviating by as much as three levels lower than the school target for that student. A key feature of the class was that verbal

responses by some students were vastly superior to their written responses particular when the task required sound logical reasoning and for this reason most students had teacher assessments that correlated more closely to their school target level then their test assessments.

5.23 Organisation of Consent and Ethical Issues

The appropriate ethics form (appendix A), was submitted to the University of Hertfordshire and approved. Permission to undertake the research was obtained from the head teacher and governors of the school. The aim and design of the research was explained as fully as possible, who the potential participants were and what the possible safeguards would be. They were also assured that in all research reports the school would be anonymous, and participant identities and contributions kept anonymous and confidential. A letter of information was provided for the parent or guardian of all the students that were invited to take part and informed consent was requested. Parents were able to contact me for further clarification and speak to me in person at school reporting days, and in all cases confidentiality was explained and guaranteed. Any decision by participants not to take part was treated with integrity and respect.

Students were asked in writing and in person if they would like to contribute to the data collection process, and what was involved was set out in both forms of communication. It was made clear that they did not have to take part, and if they did choose to participate in my research that they would have the opportunity to withdraw that offer at any time. When inviting the students to participate, care was taken to ensure that they were not pressurised to take part. The purpose and content

of the activities was explained to the potential participants, and my position as a researcher was explained. The participants were given time to think about the proposal, and were given guidelines about how to seek more information.

I was aware that sharing personal stories could be emotional, particularly when recalling memories that were uncomfortable or embarrassing. Disclosing these stories to a researcher is risky and requires you to have trust that the reader will not do or say anything that will make you regret the action of sharing a story. Because of this, collecting data as narrative requires a trust relationship between the researcher and the participant. To help alleviate possible uncomfortable feelings, after each workshop, I allocated time for students to talk, either in private or in groups, to discuss their experiences encountered during the storytelling process. In all planning and subsequent reflections, where there was a possibility of emotional or delicate issues I adopted a collaborative approach to my critical reflections. This included discussions with my supervisors and informed school colleagues who helped me plan for and, if necessary, deal appropriately with sensitive issues. I did consider that, if needed, it might be pertinent for me to seek out a more experienced researcher who was experienced with narrative research and who could give me advice with my planning and analysis, however, this did not become necessary.

Any negativity caused by the process was addressed and any future planning was aimed at safeguarding against repetition of this. Objection to the use of any data was considered and if it was appropriate that data was withdrawn.

Students and colleagues were advised that during the research references made to participants would be anonymous, replacing participant names with an alternative such as student A or a story name.

I adopted an informal approach when talking with mathematics teachers, making use of convenient opportunities. With their permission, I attempted to write accurate accounts of the discussion, and in each case I asked them to check the accuracy of the account.

The student data was locked in a secure storage environment and was not accessible by any person other than myself. The data will be shredded on completion of my thesis.

This report is for the purpose of communicating the research findings and it will be part of my thesis. My expectation is that aspects of the report will be disseminated to parents, school governors, mathematics teachers, teaching assistants and training bodies in the form of a published paper and/or seminars. As these are all public domains I am aware that the privacy of individuals is respected by; a) preserving anonymity and b) respecting confidentiality even when this results in seemingly important data being omitted from the report.

Some stories can be extremely personal and it is possible that disclosing a student story may cause unexpected discomfort or distress of an emotional nature. To safe guard for this, care was taken to ensure that no participant suffered discomfort

during or after the research, however, if this did occur I had planned to stop the research process and talk through the cause of the discomfort with the student. In addition I would have informed their parent/guardian of the situation, and if needed, I would have sought advice from the school duty of care system that has the expertise to help. During the research there were no events that caused the students noticeable discomfort, although two students decided initially not to share their story with me but changed their mind at a later date.

5.24 Phase 1 Workshop Details

To facilitate the storytelling workshop I collected together large sheets of white paper, tubs of coloured pencils, rulers, rubbers and then set off for the class room. The students saw my load and asked ‘are we going to draw today?’ ‘Yes, if you would like to’ I replied and then proceeded to explain the task. I started by explaining that I am a student also and that I go to college, I explained that I was interested in researching how school students feel about their experiences with mathematics. After answering their questions as openly as I could I explained the task. The students were asked to organise themselves into groups of three or four students and I explained that if they did not want to take part, that was perfectly fine, they could do something completely different. At this stage I did not specify what that might be as I did not want it to influence their decision to take part. The direction for the task of creating a story was deliberately left very open-ended, and I did not specify who or what should be in the story or where it might take place.

The students organised themselves into groups and started to create their story. There was a general buzz in the room and the students seemed generally interested

in the task. In each group, certain students took the lead and appeared to be compiling the story, the other students sat in a group around them adding comments, discussing points and chipping into the process intermittently. The atmosphere in the room seemed light and pleasant, and nobody indicated that they wanted to withdraw from the process. There were nine groups; they produced five cartoon type artwork pieces, three written stories, and one group created a story that was a mixture of both cartoon and story. In addition, one girl asked to present a drama of her experiences last year. At the end of the session some students asked if they could present their work to the rest of the class, the class voted that this was agreeable and two stories and the drama were presented. The other groups did not indicate that they wanted to share their story, however all stories were given to me and the students said they were happy for me to keep them.

5.3 Phase 2 Storytelling Workshops

5.31 Introduction

The purpose of phase 2 was to address some of my questions and concerns that had arisen during phase 1. I chose to focus on two particular questions which were: a) would a storytelling workshop be equally successful with students that felt differently about mathematics or had experienced a different type of struggle/failure with mathematics? b) How would the storytelling workshop run in the classes of other mathematic teachers? These questions led to the following set of aims for phase 2. The first aim was to try the storytelling workshop with a different age group and with students that may be experiencing a lack of success in school mathematics. The second aim for phase 2 was to have less personal involvement while the workshop is taking place. The third aim was to liaise with my colleagues in the

mathematics department while they try the storytelling workshop in their classrooms. I also felt that I would like to include student recordings and interviews in my data collection.

My next step was to draw up an action plan and starting points for my storytelling workshop that could be shared with colleagues interested in trialling the workshops (appendix B). Two colleagues were interested in taking part and facilitated the workshops with their classes.

5.32 Methods

I chose to run the storytelling workshop with two year 11 classes. These students were either sixteen years old or very close to that age. They were nearing the end of their KS4 secondary school education and approximately two months away from taking their GCSE exams. These classes had been compiled at the start of year 11, organised by student exam results produced at the end of the previous academic year. All these students were underperforming according to school data. By this, I mean that they had a target grade that had been worked out from their primary school achievements but they had been performing below that grade in school exams. It was considered by the student achievement officers that these students would probably not achieve a grade C or better in mathematics in their GCSE exam at the end of the academic year.

The number of students in the two groups was kept smaller than in a typical school mathematics class, each class had twenty students and it was my responsibility to

boost their performance with the aim that they would meet their targets. The students were well briefed about this situation and therefore they were experiencing a great deal of pressure from school and home.

As these students were new to me, I had made the strategic decision that I would teach them for a term before we got involved in a storytelling workshop. The rationale behind this decision was based on my assumptions about the relationship needed between teacher and student for the workshop to be successful. However, I neglected to think about the possible benefits of working with the student after they had shared their mathematical story and found that I had little time, after the workshop had taken place, to adjust my practice in light of the new knowledge gained. I now know that this was a wasted opportunity and in phase 3, the story telling workshop took place much earlier in my teaching relationship with that class.

My research experience during the pilot helped shape some of my data collection plans. I now knew, that ideally after working with the stories, it would be useful to go back to the authors and ask them to tell me more about their story and any thoughts they had about taking part in the storytelling workshop. This was also recorded as a lesson learnt in a piece of research carried out by Thompson and Hall (2008:161), 'speaking with the artist is generative and not to be omitted from the research.' Mitchell (2011) also discussed the involvement of the participants after the initial data collection phase, these 'production texts' allow the participants to talk about their work and are often elicited during follow-up interviews. To facilitate this the students were invited to go into another room and record a brief description of what their story was saying and any thoughts about the workshop.

5.33 Organisation of Phase 2 Storytelling Workshop

The students were invited by letter to take part in a storytelling workshop. They were also informed on the day of the workshop that participation was entirely voluntary and they were given a comfortable way to abstain from the process. Students were invited to create their own stories about their mathematical world. The session started with me reading a short extract from ‘The curious incident of the dog in the night’, speaking briefly about the context of the extract and the organisation of the story telling workshop.

The room was set up with different areas to work in and each area had a variety of paper, pens and colours, scissors and glue. In addition each area had a range of alternative activities for those students who did not want to write their story. I selected the alternative activities on the basis that they were mathematical and that, in my opinion, they were enjoyable to work on. Students were told that they could work anywhere they wanted in the classroom.

5.34 My Diary Extract

> *One thing that happened as an afterthought proved to be important to understanding more about the storytelling process. I had a period of reflection time during the storytelling workshop. I had made a conscious effort not to get overly involved in what the students were doing. My plan was to circulate once during each session allowing the students to ask any questions or share what they were doing. This plan was informed by the pilot workshop where on reflection I was worried that I had been too visible and that this might have influenced their stories. I had planned to spend the time absorbing the actions of the students whilst taking part in the workshop and in the midst of this process discovered that I had no real knowledge of what it might feel like to be asked to share my story. I decided that the best insight into the process was in fact to create my own story. I chose to create a story board about my education and set to work*

with a pencil, colours and a large sheet of plain paper. What I discovered was invaluable to the research process.

The idea of creating a story was difficult, so I stopped thinking about it and just started creating a story board about my life. Very quickly the process became extremely personal, I was recording events that had a particular influence on me and my attitude towards schooling, family and critical events in my life. I was particularly concerned that the students might come over and ask me a question about my story, I would answer with honesty but I felt very exposed. No student came over they were all busy with their own work. I was glad that I had chosen to keep a low profile regarding the creation of their stories; I could appreciate how intrusive my interest might have seemed.

5.35 Ethical Issues

I adopted the same precautions as in the phase 1 stage of the data collection allowing time for participants to speak to me during and after the workshop. The stories were private and were only seen by others in the group when the author chose to do so. In most cases the students did not put their names on the story, and although I knew who had written a particular story this information was not readily available to others. To try to be less visible in the room I decided that it would be useful for me to create my own story from my memories of school. This worked well as it stopped me carrying out my usual teacher behaviour of moving around the room attempting to take stock of everything. Unexpectedly, the process of writing my own story had other outcomes as described above.

5.36 The Workshops of Colleagues

At most of my planning steps I had discussed my ideas with two members of the mathematics department. The two colleagues were ones that I was in the habit of working closely with and they had both shown an interest in the storytelling workshop and asked if they could try it out with their classes. This was not an unusual request

because we often planned together and shared ideas and lessons and I was very pleased that they wanted to carry out the workshop with their classes because it added to the credibility of the process. We sat down to talk about starting points, ground rules and the materials that needed to be available. They each carried out the workshops with a class of students; the students worked in groups and produced a range of picture boards, narratives and dramas. The feedback from both teachers was positive, both saying that they found the process enjoyable and the resulting stories very interesting and informative. As the aim of this part of the research was to test the transferability of the story telling workshop in other classrooms, the stories produced in these workshops were not included as data. I feel that it was important to test whether other teachers could carry out these workshops successfully with their students because an important outcome for this research is that the workshops could be used in other classrooms to give students a way to communicate their opinion on school experiences.

5.37 Phase 2 Conclusion

At the end of phase 2 I had sixteen stories that had been written by my own students plus feedback from colleagues regarding the storytelling workshop as a process and teaching tool. I put them carefully away in art folders ready for my first chance to start the task of recording and analysing their content.

This invitation to make a short recording about their stories was accepted by five of the students; many of students took longer to write their story and did not want to spend any time on the recording. Two students also accepted an invitation to take part in a short interview about the meaning and production of their stories.

Speaking to my colleagues who had facilitated the story workshop in their classroom was also important. I felt that this data would provide evaluations and insights that will inevitably enrich the research process and help me reflect on the powerful influence the stories have on me.

5.4 Phase 3

5.41 Introduction

The purpose of phase 3 was to address my concerns after completing phase 1 and 2. Once establishing in phase 1 that students were more than happy to share their stories in a variety of formats, I used the phase 2 section of the research to look more deeply at the content of the stories. Entering into phase 3, I had a slightly different focus for the student story workshop; it would take place earlier in the teaching year so that subsequent interactions, behaviours and any developing relationships could be observed. My target participants were two groups of students who, during the last three years, had not achieved the target grades set by the assessment system of the school. I assigned myself these two groups as my teaching classes and facilitated a storytelling work shop a month afterwards allowing the students the chance to get to know me a little first.

5.42 My Diary Extract.

> *I was surprised by my reaction to the stories produced during phase 2. It was different than the way I had reacted reading the phase 1 stories. The reading process felt personal and I felt a strong bond with the person portrayed in the story. I felt frustration and regret that I had not known certain things about the student earlier in the teaching year. It seemed a waste of opportunity to understand so much near the end of our time together. In response, I felt that my teaching and interactions towards a particular student would in general, be strengthened by knowing their*

story towards the start of our time together and hence I decided that the story telling workshop should happen earlier during the academic year. I started to consider the benefits, for the author, of telling their story. More questions were starting to form as important: Could these stories be used to reconstruct their realities, to help them come to terms with conflict and discomfort? Do the stories have an influence on voice and identity?

These questions, in addition to all my initial questions, formed the basis for my inquiry in phase 3 of this research. I found myself focusing on what the stories were teaching me and how these stories were influencing my actions and teaching provision for the author of the story.

5.43 Methods

I felt that the next phase of this research should build on the questions that had arisen during the previous phases. In addition, I decided my sample should be students who were not preparing for an imminent exam and that the timing of the workshop should allow me more time to work with the student after they have shared their story. I chose a sample of students that consisted of a group of year 9 students (age 12 and 13) and a group of year 10 students (age 14and 15). Both groups had been highlighted by the school as making very little mathematical progress from entering the school at age 11 until now. The number of students in each group was kept small, (less than 20), so that they could receive as much teacher help as possible during mathematic lessons. The year 9 group consisted of 12 students and the year 10 consisted of 15 students.

5.44 My Diary Extract

I find it pertinent at this point to consider the personal dialogue that is on-going throughout this research. I ask myself 'have I got the students best

interests at heart?' There are two reasons that influenced the selection of groups for my phase 3 storytelling workshop.

The first is based on my belief that everybody can, and should, learn mathematics. I define learning mathematics as a fusion of acquiring an understanding about particular mathematical concepts and gaining the confidence to feel comfortable demonstrating this understanding. I also believe that it is the latter part of that union that underpins my philosophy when teaching mathematics, create space for the comfortable confidence and the learning will happen. Evolving from this stance is then the political influence, the lack of a mathematical qualification can block career pathways and hence, all students should be allowed the best possible chance to achieve the qualification they want and/or need for their future.

The second reason is influenced by school politics and league tables. As a leader of a mathematics department I am constantly under pressure to improve the statistics reported for school league tables. I have monitored the student progress at my school for many years, and have found that historically, students who are constantly underperforming in maths throughout their secondary school education often fail to achieve that much coveted C grade in GCSE mathematics. I believe that attention to these students could make a profound difference to school statistics.

So although I am adamant that I have the student's best interest at heart I must also state that it is in my interest also.

5.45 Organisation of Phase 3 Storytelling Workshop

I built on the classroom planning that had worked in the previous phases, setting out around the room workstations that contained materials to use when creating the stories plus other items for those that did not want to take part. I explained to the class that I was a student and that I was interested in their stories about learning mathematics. I explained that they did not need to take part if they did not want to and gave them some instruction regarding the materials placed around the room and the time I had allowed for them to create stories. Both classes created stories and appeared to enjoy the process. Some students chatted as they worked; other kept very quiet and worked in private. I did not circulate. We used 3 one hour slots to produce the stories. Some students were absent for part of the time. I had learnt from the previous phases that a lot of time can be used up decorating the story page,

often before the story is written. I asked them to get their story in place first before they concentrated on the colouring and decorating. The stories produced were mainly written texts with drawings around the outside. Three were in a fairy tale style, two were songs, one was written as a poem. The rest were accounts of memories and events. Nobody asked to share their story with the class, but one student asked if she could have her story back and did not want anyone else to see it. I put it in an envelope and returned it to her and a few days later she gave it back to me and asked me to keep it. One group produced a second story six months later. This was called the next chapter and they were asked to write how they would like their mathematics story to continue. During the process the questions that played on my mind were similar to ones in other phases. Why am I attracted by some stories, and how do I set up an analysis that is inclusive of all my students?

5.46 Ethical Implications

Again in this phase, I built in time at the end of each storytelling session for the students to talk to me about any particular issues and several did stay behind to speak to me. My main concern during this phase was how best to deal with the stories that contained negative facts about other teachers, particularly those teachers that I have responsibility for? It is important to me that I respect both the integrity and professional position of my staff, and I firmly believe that teachers in general, enter the profession because they care about young people. Yet it is important that I hear what my students are saying and that their position and opinion is respected. In this phase, one story focused almost entirely on the behaviour of a teacher and how the author felt about it. The student author was clearly distressed by the episode and was experiencing strong emotions about teachers in general.

Other stories featured teachers shouting and not being in control of classroom behaviour.

From my perspective, there was no story content describing teacher behaviour that came as a surprise. I was already aware of the staffing issues within the department and these members of staff were already receiving support. As stated in chapter three, many details contained in the stories were a private matter between author and reader and it would be unethical and unnecessary for me to share this information with others. However, I felt that the strong negative emotions expressed by one story writer and the obvious discomfort that she had experienced in a mathematics classroom needed to be addressed. I waited for a comfortable opportunity to talk to this student and had decided that if the situation could not be resolved in this way I would seek guidance from colleagues with a more professional understanding of counselling.

5.47 Conclusion

The data produced by my research participants was varied and rich in content and form. I found myself spending hours reading the stories and dwelling on what they might mean to me personally, and how this knowledge helped in my quest to improve my teaching practice. To focus myself on developing this specific research project I realised that any analytical framework that I decided to work with must address the research questions that this work is developed around.

The potential danger in this approach is that the stories seem to be uniquely individual, and in looking for pre-decided themes and patterns, I could find that I disregard something important particularly if it only occurs in one story. To try to reduce the risk of overlooking significant areas of interest that address my research questions I designed a data analysis plan the uses the ideas of triangulation (Bell, 2005) to approach the data analysis in a number of different ways. This approach I have described as a hybrid approach, a name taken from the work of Fereday and Muir-Cochrane (2008).

The term triangulation refers to a strategy to improve the validity of research findings by seeking convergence among differing methodologies and data sources. The primary purpose of triangulation is to find agreement even when the methods are varied. However, this is difficult when dealing with qualitative studies. In cases like mine, triangulation is used by including in the research more than one data type, with a view to compensate for potential weaknesses that are inherent in any particular data. This way triangulation is used with an aim to exploit the strength of a particular data type and neutralise the weaknesses of others. The next chapter develops my data analysis model which draws on the strengths of thematic analysis (Fereday and Muir-Cochrane, 2008), intuition and teaching experience, culminating in a teacher narrative that describes the powerful role of the stories and the influence they have on practice.

Chapter 6: Data Analysis Model

6.1 Introduction

The aim of this chapter is to present a rationale for my approach to data analysis and give an overview of the developing intuitive approach. In the spirit of methodological inventiveness (Dadds and Hart, 2001), and my need to search for an approach that would serve to echo student and teacher voice, I developed an intuitive inquiry model that was complemented by my strengths, experience and desire to represent in a liberating fashion, the voice of my students. The diagram below represents the components of this intuitive inquiry approach.

Figure 3: Intuitive Inquiry Diagram

6.2 Intuitive Inquiry

The powerful stories convinced me that I needed to look at a different form of data analysis, one that had a place for the way the stories had worked on me. I found my solace in the ideas of intuitive inquiry (Anderson, 2011), and it is through this way of working that the stories started to become powerful mediums by which I could negotiate my understanding of the relationships between both teacher and student, and student and mathematics. The model of intuitive inquiry proposed by Anderson (2011) correlated closely with the way that I had instinctively started to work with my stories. It offered me a structured yet flexible approach that recognised and utilised my extensive experience of teaching school mathematics. I adapted the main techniques of Anderson's model to suit the research methodology that underpinned my work and the type of data collected for this research. I also utilised the process of thematic analysis to complement and support this intuitive way of working. This multiple way of working with the data highlighted my insider/ outsider positioning, my diary extracts creating subjective data shortly after reading the student story data, yet my analysis of the stories away from the classroom giving me the opportunity to analyse the data as a pseudo outsider research.

Using and adapting the intuitive inquiry work of Rosemary Anderson (2011) helped me compile a model of intuitive inquiry analysis that I could apply to my existing action research process. It was my intention throughout this research that the method of analysis used was one that would preserve and celebrate participant voice, expose the powerful emotions communicated and transferred by the stories, and represent the diverse forms of stories created by the research participants. During the development of my analysis method I experimented with a variety of analytical approaches but always felt that they fell short of representing a) the

complex subtleties communicated by the participant, and b) the emotion and transformative experience that touched me as I read my student's creative texts.

Figure 4: Intuitive inquiry model

	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5
Anderson (2011)	*The researcher clarifies the research topic through a creative process*	*The intuitive inquirer reflects on the topics in light of extant literature and prepares a list of preliminary lenses.*	*Collecting data and preparing prescriptive reports*	*Transforming and revising interpretive lenses*	*Integration of findings and theory building*
What I did	**Select texts are relevant to the research inquiry.** During phase 1 (pilot phase) of the research certain stories caught my attention and forced me to reflect on my interactions with the student, and on my practice. I repeatedly returned to the stories over a period of time engaging with the stories on a regular basis recording both objective and subjective thoughts, impressions, intuitions, observations, daydreams and conversations. In addition I developed a set of questions to apply to each story (pg 151) and also used the process of thematic analysis (Bryman 2008) to look for similarities. Eventually when the process felt exhausted I compiled a list of the main themes that feature in the data.	**Explore extant literature.** Using the key themes and ideas arising from my reflections on the stories in cycle 1. I reflected on these with knowledge drawn from relevant literature and my experience of these areas.	**Collect data** I collected new data in the phase 2 and phase 3 section of the action research cycle. The selection of data sources was designed to test ideas, address certain questions and challenge certain assumptions.	**Work with the data** I repeated the processes of imaginal dialogue and other analysis methods with these new stories from phase 1 and 2, rethinking and revising the analytical lenses developed in cycle 1 and 2.	**Write a report** In this cycle I finalised my understandings of the data analysis outcomes, thoughts and ideas from each phase. Using these I compiled a report, interpreting the main themes and their implications for teacher practice and future research.

6.21 Intuitive Inquiry Step One

Using phase 1, the pilot phase of my action research model, I examined the available texts. These were in the form of student stories, my observations and events noting which in stories in particular resonated with my original understanding about school students learning mathematics. I also found myself emotional drawn to stories that contained pictures and/or text that conveyed student emotion. Most of the stories surprised me, I felt that there was a great deal about these students and their mathematics that I had not appreciated before reading the stories. All student stories in this phase were utilised as data, yet I felt it necessary to think deeply about why some stories played on my mind and I have tried to communicate this in chapter 7 in my discussion of themes, and in chapter 9 where I select individual stories to discuss. I spent a great deal of time pondering why particular stories seemed particularly powerful and played on my mind, and I now accept that, as advised in the intuitive inquiry approach, my intuition was being stimulated and they were those that identified with my passion as a researcher and mathematics teacher. Reflecting daily on these selected texts I recorded objective and subjective impressions, observations, intuitions and questions, including why I thought these texts had caught my attention. After a period of time I began to understand that the stories that I was pondering about focused on students that displayed behaviour that indicated that they struggled with their mathematics at some stage, and their stories suggested that these students were fighting to belong to the world of mathematics and that they were in the process of shaping a mathematical identity.

From these I prepared some headings by which I could examine new data collected from different participants. Examining my assumptions and values helped me to embrace an imaginal dialogue, which in turn influenced my selection of groups in the next phases of this research.

6.22 Intuitive Inquiry Step two

I returned to my notes made from the literature that I had reviewed to date, I examined new literature relevant to the topics that had appeared in the selected step one texts and actively sought to support, refute and examine the story perspectives that became my headings for inquiry. My literature review in chapter two is the resulting discussion that stemmed from my work undertaken in step two of the intuitive inquiry process. At this stage the work was still very fluid, moving back and forward between my ideas drawn from data and experience and my understandings of extent literature. This process allowed me to simultaneously prepare my questions and headings that would drive the next section of my research.

6.23 Intuitive Inquiry Step Three

I identified the research participants that I wanted to collect new data from, facilitated the storytelling workshops with the groups, collected data with respect to my actions, feelings, thoughts and intuitions both during the data collection process, afterwards while reading the student stories and in subsequent interactions with the authors of the stories. At the same time two of my colleagues also facilitated the storytelling workshop with their own students. This complemented the phase 2 and 3 sections of the action research process. At each step I prepared diary reports with as much description as possible.

6.24 Intuitive Inquiry Step Four

Using a variety of data analysis techniques I set about looking through the data for patterns, correlation of ideas, and key themes in order to modify, refute, reorganise and expand my pre-understanding of the topics raised in the data. At each step I used a reflexive process to examine my assumptions, bias and intuitive breakthroughs, building an imaginal dialogue into the data collection process. I spent a considerable time moving back and forth between student stories, reflexive writing and discussions with peers, sorting and resorting data, and examining extant literature that were in steps two, three and four of the intuitive cycle.

6.25 Intuitive Inquiry Step Five

Eventually, with great difficulty, I moved away from the data collection, interpretation and reflexive dialogue processes and considered all aspects of the study, paying attention to include both objective and subjective findings. Embracing this research genre, I set out to communicate findings in an embodied manner, derived from my own personal values, assumptions and experience. Woven throughout the findings I have included extracts and images from participant's stories and my intuitive insights in the form of my diary extracts. The purpose of this style of communication was to retain and portray the fullness of the participant student voice and my personal perspective and knowledge gained throughout the research.

6.3 Thematic Analysis

It is recommended that the intuitive inquiry approach is combined with other, more explicit and confirmatory approaches (Anderson, 2011). I had originally set out to work with a content analysis approach to data collection but I found that coding and dissecting the stories into very small sections had the effect of losing the actual

story. This process seemed to skew the data into something that was unrecognisable and meaningless and did not fit well with a narrative approach to the research. It seemed that sections of the stories used contradictory expressions that made more sense if kept as a theme rather than separated into components. Braun and Clarke (2014) described thematic analysis as an approach to qualitative research that is deliberate, reflective and thorough. I used a thematic analysis approach to data analysis on one group of student stories in each phase. I approached the thematic analysis in two ways. For one method, I used a scissors to separate the stories into sentences or clusters of sentences depending on the content, for example, if the next sentence was directly related to the previous I kept them together. The strips of paper containing the sentences for one group of students were then shuffled to ensure that my selection was random and I entered a sorting process, putting sentences together if they seemed related to each other. I noted the themes that emerged and at a much later date repeated the process. This process was also executed by colleagues to give some fresh thoughts to the process. I did not mix the sentences for particular groups because I had noticed early during the work that particular groups had influences that were particular to the group, for example a problem with a particular student or teacher. This information was not directly relevant to my line of inquiry and I wanted to keep it visible within the group so that I could make a decision at a later date about its contribution to my data analysis.

In addition to breaking the stories into sections, I also read them as a whole noting down emerging themes. These themes were intertwined with my impressions of the particular class and my reflections of our classroom interactions. They were laced

with my subjective understandings, my intuitions and my dreams for the future of that class. Generally I would be alarmed that the researcher is using such a personal, subjective and obviously biased way to view data, but I knew that ethically my intentions were in the interest of improving what I do for the students. In support of my action research approach, this form of data analysis drives a reflexive approach with a view to alter practice through an understanding of the needs of a particular class. This process of noting emerging themes from stories was repeated after a few weeks. The themes were then organised into groups that appeared to have common links and this also was repeated several times at a later date. Eventually, when the process seemed exhausted and no new themes were emerging I began to explore how the resulting themes in both thematic analysis methods related to my research questions.

6.4 Conclusion

The data analysis model evolved and adapted with progress through the action research phases. There were many false starts that included a coding process, recording and counting positive and negative attribution to mathematics and its learning, and looking for repetition of words. These ideas and the contributing work seemed to move me away from the story lines and the messages contained in the stories, yet served an invaluable place in familiarising me with the stories and helping me develop an analysis plan that celebrated individuality, student voice and the powerful influence that the stories had on subsequent teaching and learning for those students. In the next chapters I will develop the final phase of my four cycle action research. Chapter 7, 8, 9 and 10 contain examples of selected student stories from phases 1, 2 and 3 and the development of the related data analysis that took place in the final phase.

Chapter 7: Data Analysis Phase 1 Pilot

7.1 Introduction: My Diary Extract

> *I enter this section of my research like a beginner meandering through a new library. I feel overwhelmed by the question that my colleagues and interested parties ask, 'How are you going to analyse your data?' I want to be flippant and say that I will read it and think about it, I will manipulate and try to learn from it. But I know in my heart that ignorance is bliss, and if I just take this path through my meandering I will be in danger of over simplifying through ignorance*
>
> *Analysis is spoken of as though it is a recipe to achieve something, such as; 'how will you bake that cake? I wish that applying a series of steps taken from a known model would convince me that I my objective would be fulfilled, namely to connect my thinking and provide some insight into the personal difficulties encountered by students in their mathematics lessons. Each time I move forward I find myself lost in a strange place with no inter- connecting routes to a familiar ground.*
>
> *Yet, I recognise analysis to be intertwined with every thought I have about my research. It is a process that has a place in every step of the research, from the initial thoughts and planning right through to the final conclusion in my write up. Perhaps that is why I find the question 'How are you going to analyse your data?' so confusing, it is because I am already analysing, my research analysis is not a separate part of the process. It is just so natural that I cannot name it, yet I must for the clarity of this research. The student stories are situated in the present and are written for me, their mathematics teacher. They elicit a reading in the present and any delay in this process fills me with guilt. What I am trying to say is that inevitably an analysis occurs at the reading of the stories and the subsequent thinking and actions that occur in retrospect is elicited by this initial analysis. My search through the relevant literature serves to help me make sense of this seemingly knee jerk analysis and perhaps how student stories about learning mathematics could contribute to improving the practice of mathematics teachers in general.*

In this section I describe my path through my data analysis, highlighting changes in direction and where literature has influenced and developed my response to 'How will you analyse your data?' The student stories are presented as they were written, their grammar is preserved but some spellings are corrected for ease of reading. Layered intermittently between the stories are extracts of my diary which are my reflections written during the research period. I cannot speak for the students, I can

only speak for myself, yet my story cannot be separated from the student story, what is inside me, also shows on the outside through my intuitions and actions. I will read and think, I will manipulate and try to learn, it is an on-going reflexive process that tells its own story.

Each story and its corresponding diary extracts will be supported by an inter-text which maps out the literature, my thoughts, the political climate, and my field notes supporting many of the ideas put forward. By moving between a student story and that of the teacher, I hope to create an understanding that does justice to the students who took part in this research and simultaneously broaden my own understanding as a teacher, of the influences that my thoughts and subsequent actions have on the student learning in a mathematics classroom. The style of presentation is my effort not to drown the student stories with the sound of my own voice. The aim for this style of presentation is to include many voices and to offer various levels of knowing through which a reader can make their own sense. In this way meaning is not dominated by any voice, thus allowing the reader to make their own interpretation relevant to their experiences.

7.2 Intuitive Inquiry First Step: Using Phase 1 Stories to Compile Initial Lenses

The purpose of the pilot phase of this research was to investigate the use of a story telling workshop as a method for collecting rich descriptive data in a relatively non-intrusive way. I feel the outcome of this phase was very encouraging, the atmosphere of the workshop was positive and the students created nine stories that varied in format. In addition to the original purpose, the stories produced rich and

thought-provoking data, some of which caught me by surprise and attracted my attention because the stories challenged my assumptions about my practice as a teacher. I have always strived to be a careful, considerate teacher who promotes a view of mathematics that echoes my values and beliefs. These stories, by challenging my assumptions, prompted me to enter into a personal critique of my classroom practice and the model of mathematics that I was promoting in my day to day practice. At first I felt a little deflated at the thought that I might be promoting, in my practice, some of the images and teacher models depicted in the stories, but I quickly began to understand that I had been given an opportunity to look, all but briefly, inside the world of a student studying mathematics, a process that could potentially be used to improve the practice of all mathematics teachers.

An analysis of the content of the stories had not been part of my planning for this phase of the research, but the draw of the stories, the emotion they contained and their potential to transform my thinking about the mathematics classroom made them ideal texts to select for the first step of an intuitive inquiry process.

The pilot phase of the research produced eight stories and one drama. Each story was given a title based on a feature of the story. Acting on the advice of Mitchell (2011) I set up a digital archive of the student drawings. The eight stories can be seen in appendix C, the drama was a spontaneous contribution and was not recorded and therefore I have not included it in the pilot data. Originally, in my first attempt to obtain ethics approval I had said that I would like to video the student workshops and any subsequent data that was produced. I had included this in my

planning because I felt that there was a possibility that the data night be visual and therefore should be recorded for accuracy and reader interpretation. It was felt, by the ethics committee that this data should not be recorded and therefore that section of the ethics application was withdrawn. In light of this, I could not include an accurate account of the drama produced in the workshop. The student that created the drama also contributed to one of the eight other stories and three years later independently wrote her adult mathematics story which forms part of the concluding chapter. I looked at the stories daily as recommended by the intuitive inquiry model, recording my thoughts, ideas, impressions, intuitions and surprises, and over a period of time several themes began to feature in my daily notes. I wanted to be playful with my exploration of the data, testing out analysis methods to get a feel for what type of analysis seemed to work. By considering the objective content of the stories I entered into a procedure that used coding (Bell, 2005), to highlight any patterns and connections in themes. This is a technique used to extract information from a body of material by systematically and objectively identifying special characteristics of the material (Bell, 2005). The characteristics I chose to identify were critical incidents about learning mathematics that were communicated through the student stories. I considered that these incidents were memorable to the students evident by their inclusion in the story, and hence could be considered as important data.

Characteristics of learning mathematics that were identified through this process were classroom climate, the role of the teacher, student and parent beliefs about mathematics, anxiety, emotions in general, moods, motivation, personal causation, and student values. Aspects of this content analysis were very useful in the

identification of institutional and individual teacher practice, and identified common themes that, as a teacher and school manager, I felt I needed to address. One particular theme highlighted by the students during this pilot phase was their dislike of having many different mathematics teachers; it would seem that they would prefer to stick with one teacher regardless of the quality of that teaching. In the current educational climate, in which there is a shortage of mathematics teachers, this aspect of the research associated with a constant changing of teachers is an area that I could explore in more detail.

From the pilot phase, I began to understand that knowing the particulars of student experience and opinion could inform my practice as a school manager and as a classroom teacher. In addition, my subjective impressions were noted as they occurred, these feelings, intuitions and ideas were compiled across the stories and I kept a diary of any writing that surfaced during imaginal dialogue. I then, put together a list of questions that I could apply to each of the stories to help me look at their content in more depth. These questions were compiled from notes that I had jotted down during a number of literature reviews on the subject of mathematics and school mathematics. Applying a set of standard questions also helped me overcome the emotional draw that I felt when reading some of the stories allowing me to distance myself a little from the data. I looked at each story in turn, making a comment under each question heading which was recorded on the computer. Each story was given a different colour and printed out. Under each question heading I then compiled the various comments.

The list of questions that I decided to apply to the student story was influenced by the ideas of symbolic interactionism. The conceptual framework that drives this research design is one that views learning mathematics as a social act and in my attempt to devise different ways of looking at the data I was attracted to the work of Blumer (1969), who is responsible for coining the term symbolic interactionism. I became aware of symbolic interactionism through the work of Fiona Walls (2009:2003) while I was looking for research about students learning mathematics. Her research 'explored the ways in which primary school children developed understandings about mathematics, mathematical 'learning' and 'knowing' and themselves as learners of mathematics (Walls, 2003:2). This was established by looking at ways in which children made meaning through social interactions with mathematical learning environments and how this influenced the learning of mathematics. The study carried out by Walls (2003) excited me because it was the first work that I had found that seemed to have close correlation with the purpose of my investigation.

Through the work of Walls (2003) I was introduced to the 'social world of pupil career' by Pollard and Filer (1999), which is a report on several research projects that studied the 'social world' of pupils and in particular the ways in which children interpret and then respond to classroom, playground and family contexts. A key theoretical influence for both these researchers was symbolic interactionism which has a focus on the way meaning is developed through social processes. From a symbolic interactionist point of view, children make sense of mathematics in their social world by means of negotiated meanings, and these are expressed through understandings, feelings, opinions and beliefs, by way of social interaction through

shared activities, events and experiences. The use of a symbolic interactionism perspective for looking at my research seemed a sensible way for me to look at the data because this approach focuses on the creation of meaning as people interact together in both verbal and non-verbal communication. In addition, while the approach recognised the individuality and therefore uniqueness of each person, (in this case the students learning mathematics), it also acknowledged the importance of social interactions with family, peers, teachers and environmental objects such (books, teachers, classrooms and work), with which each individual negotiates personal meanings through interactions with others (Walls, 2003). Symbolic Interactionism attempts to probe into the hiddenness of the structures and processes that generate their mathematical world encouraging a sociological attitude by which to uncover and make strange the features of a child's social world of learning mathematics (Yackal, 2004).

The questions I compiled are listed below and were used as a framework for looking at the stories in more detail.

7.21 List of Questions Applied to My Data

How do the students' stories represent school mathematics?
What seems to be important in the world of school mathematics?
What is the story saying about the classroom discourse?
Is there evidence of taken-for-granted classroom practices?
What emotions are displayed in this story?
How does the student appear to feel about mathematics?
What is the story saying about the school?
What do the stories say about mathematics?
What is the story saying about the teacher or teachers?
Is there any indication of cultural and social influences?

What is the story saying about past experiences with mathematics/ mathematics lessons/ learning/assessment?

What is the story saying about learning (mathematics)?

Who are the dominant players in the story, what is this saying about power?

What is the role of adults in the story?

Where does 'identity' fit with these stories?

How is language used in the story?

A process of thematic analysis, intuitive notes and applying a variety of questions led me to compile several lists of themes. Appendix D shows the preliminary work applying the questions to the pilot phase stories. The process of moving from the questions to emerging themes took several months because I needed time to move backwards and forwards between both my interpretations of how each story addressed the questions and the whole story content as a complete unit. Each question had a list of statements that represented my interpretations of the stories relevant to that individual question (appendix D), and these were colour coded by story so that I could return to the particular story periodically which then allowed me to check that my interpretations had not changed. For each question, I then produced spider type diagrams, grouping and regrouping the statement listed under that question, exploring possible thematic links between the statements. After each exploration I returned to each story as a whole looking at the pictures and text that addressed these themes. Initially I had many themes but I found that many of the themes were similar and could eventually be placed under one heading. Both the objective content and my subjective thoughts began to have links and after a period of time I settled on the following five headings as my main lenses for the next steps of an intuitive inquiry data analysis process. I have included a discussion of each theme to give my reader an idea of the data and thinking that created them.

a) The faces of mathematics

b) Power and status of mathematics

c) Freedom

d) The culture of school mathematics

e) Relationships

Within each of the selected themes above, I sorted the many descriptions relating to the theme into groups, recording my reflexive ideas and thoughts. This process was repeated on several occasions rearranging the connections between the statements, all the time jotting down my ideas, imaginings, objective and subjective insights, impressions, intuitions, observations, daydreams and conversations, both with myself and others**.** I have included a few extracts from the data and some of my intuitive notes to help the reader follow the data analysis process.

7.3 The Faces of Mathematics: Pilot Data

The first of my perspectives from the stories focuses on the view of mathematics portrayed in the student stories. This I have called ‘the Faces of Mathematics’, the name of the theme is terminology that supports embodied writing and an intuitive realisation that, for many students, mathematics is a complex social activity which presents itself in multiple forms, each form presenting a unique perspective of what it is like to learn mathematics. The inspiration for the name originated from a paper written by Hoyles et al (2010).

What mathematics is to students varies greatly, often within the same story, and is often influenced by their feelings towards the activity they are taking part in. Story 1

(PhD) shows mathematics to be a about numbers and operations. The pictures suggest it is something that is told to you. It is portrayed as making the student unhappy and appears to be something to fear. The blue masked mathematics is presented as an opponent, perhaps an enemy and appears strong, male and needs to be overcome.

In story 2 (Swiss roll) the story also depicts mathematics as numbers and operations in a relationship. This student also seems to be unhappy with mathematics. She has drawn angry faces, sad eyes and startled or confused expressions and in another place she describes mathematics as baffling. Mathematics seems to be a process by which students are ranked and this student has placed herself in the position of last. There is an indication that mathematics is about right and wrong answers. The story has symbols referring to prison, lack of freedom and 'no go areas', this gives me an impression of imposed sanctions, not belonging and a lack of freedom.

Story 3 (Cinderella) presents a face of mathematics that is about thinking skills, knowledge, preparation and working hard. It also implies that mathematics is powerful as a selector of status. I get the feeling that this student views mathematics as fair and just, her message is that it is not just about ability and if you work hard you will get good results. It is a happy ending story and gives me the impression that she thinks maths is good.

Story 4 (Heart) suggests that mathematics is about number, shape, and mathematical operations. Tests are represented as a theme in this story and results feature strongly. There is an indication that mathematics is a measure of cleverness.

Story 5 (Keep trying) shows mathematics as algebra, answering questions, passing tests, and learning by rote. The student shows lots of questions in her head and some frustration. This story also shows mathematics as something that is told to you, something that is difficult and requires a lot of work. There are pictures in this story that suggest that the student is confused and unhappy because of mathematics.

Story 6 (Seventeen) indicates that mathematics is not about copying pages from books.

For Story 7 (Sweets), mathematics is about exams, discomfort and sanctions. Mathematics can mean staying quiet and perhaps isolated. Mathematics appears to be stressful and the pictures show a change in the student when she is not doing mathematics. There are pictures suggesting that the student is miserable, stressed and nervous during mathematics and the story depicts relief, happiness and freedom when not doing mathematics.

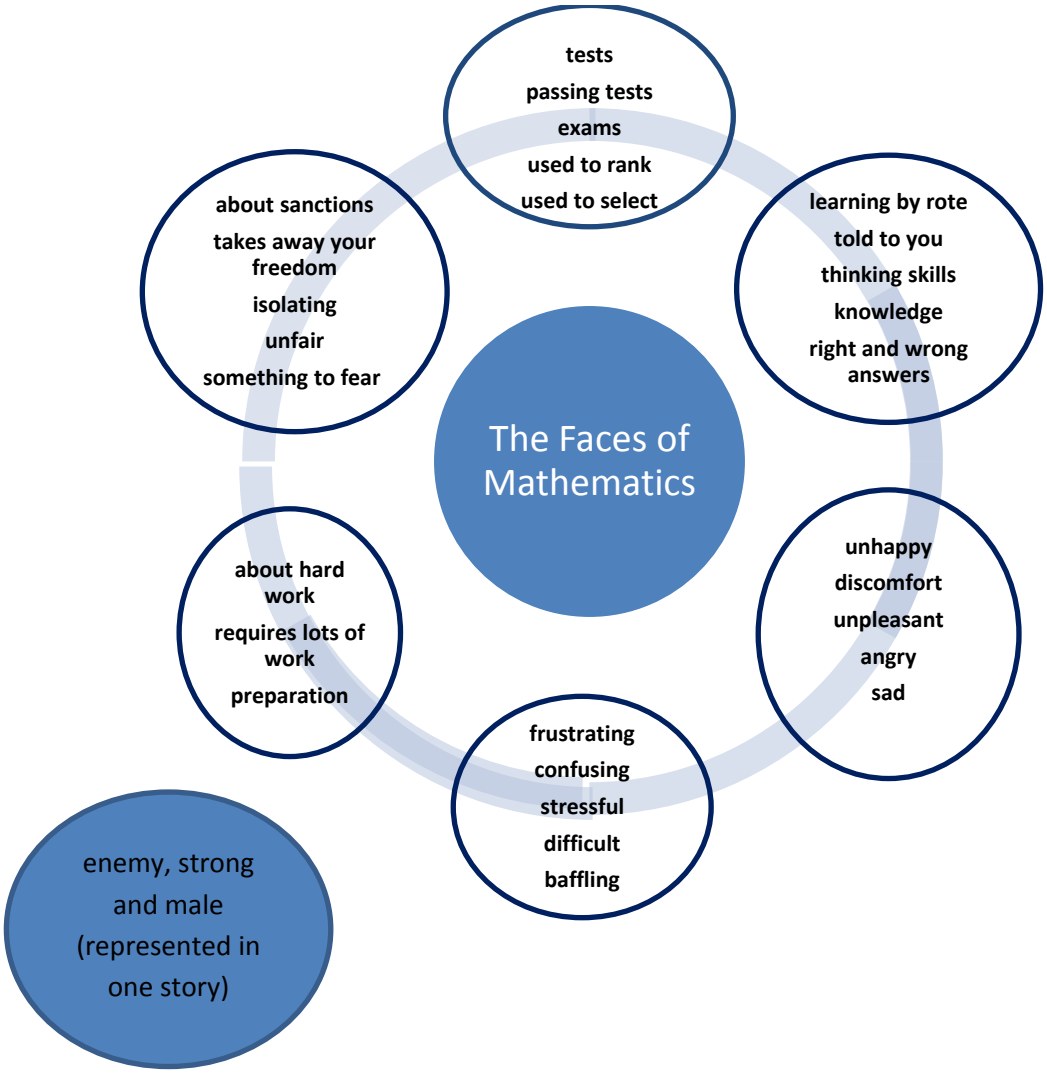
Story 8 (The Aye) represents mathematics currently as an unpleasant experience. Past experiences with mathematics were enjoyable but current experiences are confusing and unfair and this student does not like mathematics at the moment.

Revisiting my original research question '**is learning mathematics an uncomfortable memory for many people, and if so, why?** I can now suggest that the data from my pilot indicates that most of these stories indicate that at the moment the answer is yes, mathematics is described as an uncomfortable experience. Even at this young age their memories of learning mathematics bring up many images of discomfort and unhappiness. The reasons why, seem complex, but

clearly tests and test results feature in many of the stories. Interestingly, in the story that does not explicitly represent learning mathematics as uncomfortable, the view of mathematics is one of thinking skills, knowledge, preparation and working hard. Even though the stories show unhappy feelings doing mathematics, most stories show a happy ending which fills me with optimism that these students are determined to succeed no matter how difficult the journey. I feel that, as a mathematics teacher, with the knowledge obtained from the stories, it would be prudent to build on the optimism presented in the stories perhaps addressing the reasons why these students feel so unhappy about their mathematics.

In the case of this class, once the stories were shared and I had read them in depth, I could start to think about their view of mathematics and the view of mathematics I wanted to promote. The figure below shows the results of grouping ideas relating to the faces of mathematics portrayed in the pilot stories. This grouping produced the following headings: Mathematics is a measurement and/or ranking method; Ways of learning mathematics; Mathematics is not nice; Mathematics is difficult; the effort required to do mathematics; a lack of liberty associated with doing mathematics. The group in blue did not seem to fit with the other groups.

Figure 5: The Faces of Mathematics



7.4 The Power and Status associated with Mathematics: Pilot Data

This became a theme because all the stories except the drama contained references to happiness or an elevated status, due to some type of achievement in mathematics. The stories depicted results in tests, high qualifications or position in society and I felt that there was an association between status and power.

In story 1 (PhD) the story gives the impression that the student is taking part in a battle and depicts the tensions that surround this situation, winning and strength are

featured and seem to be valued. Power plays an influential role showing a transfer of power from a powerful mathematics person to the student when mathematics had been successfully defeated. Status in mathematics is featured by the story suggesting that overcoming difficulties in mathematics can lead to high qualifications, and the student has listed a qualification and a university that most would generally consider as associated with very high achievements.

In story 2 (Swiss roll), status is featured through her picture of a rosette and her rank position as last. The story shows the student as a prisoner and this seems linked with a mathematics sign with no entry lines across it, implying to me that mathematics has the power to trap this student.

In Story 3 (Cinderella) Mathematics is used as a selection tool by the prince, whose title suggest that he is somebody who is in a powerful position. Mathematics has status and authority because your place in society is dictated by your mathematic achievement.

In Story 4 (Heart) the power is with the mathematics test, as it seems to provide a ranking system for cleverness. Heart seems to be powerful in the fact that she perceives a problem and makes the move to correct it, carrying hexagon with her. The tutor has the power to help heart sort out the problem, this suggests that in this case power is knowledge and perhaps, as in the case of the tutor, you are powerful because you are outside of this school culture.

Story 6 (Seventeen) is unusual because it criticises the teacher for not having power over the class, and the story gives the message that for this student to learn mathematics there has to be someone to control the situation. The adults in the story are portrayed as powerless, incompetent, unfair and foolish and this is not a good

situation. It is suggested in the story that the students held the power and were able to bully the teachers but this power was not used to promote any learning.

Story 8 (The Aye) also talks about the students taking control and gives you a sense that the companionship between the students makes them powerful. However the teacher holds some power as they are able to impose sanctions and punishments.

7.5 Freedom: Pilot Phase

This heading was derived from references in the stories to a lack of freedom. I have taken a definition of freedom that includes belonging to, and being part of something, the freedom to take part in something. My interpretation of this category is subjective but I feel it is worth exploring because I believe that it has an influence on mathematical identity or the lack of it. Several stories suggested a culture of isolation and not belonging. Story 2 (Swiss roll) in addition to showing prison bars links maths lessons with sanctions and detentions. It shows mathematics with a no entry sign and you get a feeling that this student feels she is not part of the mathematics community. There is a similar impression portrayed in story 7 (sweets) the girl seems isolated and alone, she appears to be struggling and unhappy in the mathematics context and suffering personal image problems when released from that situation. Her behaviour seems impulsive and uncomfortable, and we could suggest that she has some general personal issues, but as this student has displayed them in her mathematics story I deduce that this behaviour is linked to learning mathematics. She indicates her position by including the diagram of a student eating a lolly in the mathematics exam despite the notices that say no eating. I think this is her way of saying that she is different and refuses to conform. There is a suggestion in several stories that mathematic lessons are linked with detentions, feelings of being trapped

and are not always happy events. Intuitively, I perceive in these stories an air of loneliness and misery and this makes me feel that these students do not identify with doing mathematics, and one story supports this feeling by indicating that the mathematical world would not be their choice and that they are forced to do mathematics.

7.6 The Classroom Culture of School Mathematics: Pilot Phase

This theme refers to the student expectations of the mathematics classroom, what they think it is to 'do' mathematics, what the students think the teacher expects. My notes at the time of the pilot contained the following impressions from the student stories.

The image of the teacher seems to be a key factor in how mathematics is perceived. Teachers can control whether you enjoy mathematics. The teacher has to be 'normal' and take charge of the class. To learn mathematics there has to be some control, and/or respect and you cannot learn if you have lots of different teachers. Classroom sanctions can be unfair and you have no way to represent your side of things. The stories paint a fairly formal image of a mathematics classroom. The teacher is standing at the front of the class, working from a board and asking the students questions, and the students raising their hands to answer. The students are sitting at a desk on their own. Worksheets seem to be a feature of a mathematics classroom and the work completed quietly (or in silence). Making students write out sections of text to keep control is mentioned in one story and taking tests and getting the results back is common throughout the stories. Some stories carry the message that it is important to try hard and be prepared, to be able to answer questions in class, and to keep trying until you are successful. One story suggests that by doing

this you will please the teacher. Two of the stories suggest that it is important to do well in tests and to be successful you need to be the winner. Place order and ranking is an important feature of all the stories.

7.7 Relationships: Pilot Phase

There were a number of relationships embedded in the stories, many focused on the class and student relationship with the teacher. This is not surprising to me because this class had been taught by a number of mathematic teachers due to staffing problems and had been very vocal with their complaints about this situation. In one story the student is pictured with the teacher in a classroom scene where the student is unhappy when she does not know the answer to a question posed by the teacher, but very happy when she does. My thoughts here focus on who or what the student is trying to please. In addition some stories featured the role of parents and other students. One story mentions a tutor who helped the students be successful at mathematics. Two stories feature parents, in one the student is small and the parent is drawn in a way that makes them look very dominant and the pupil looks unhappy. In the other the parents are pointing a finger and shouting and the pupil appears to be shrinking. Both stories show an uneasy relationship with parents because of mathematics and show a family interaction to learning mathematics that is scary and hated. The story called Heart suggests a peer relationship between students; this appears to be a supportive relationship.

Interestingly, I had not seen these themes in my day to day work with these students. I had assumed that this was probably because they were in general, writing stories about the past and in my lessons we are interacting in the present. The class had appeared to me as a lively, hard working group, full of ideas and

imagination. After reading the stories however, I started to notice the signs of anxiety and vulnerability in some students and I began to realise that before the creation of the stories I had interpreted these mannerisms differently. Knowing the stories encouraged me to critique carefully my responses and instructions that I used in this classroom, checking that they were not exacerbating any situation portrayed in the stories.

7.8 Discussion of the phase 1 Pilot Phase

I struggled for some time with the analysis of the student stories. There were a number of questions that featured in my thinking and these were: What story is being told? What is the student doing by telling this story? Who is the story for? What am I learning, and how does knowing this story improve my practice to this student and to mathematics learners in general?

A considered approach was my decision to use some themes and not others. Many stories listed mathematical topics, for example mathematics is about numbers and number relationships. One story was in the form of a poster promoting mathematical topics. Learning times tables was featured, also fractions and algebra. It is not surprising that stories contained lists of topics because the content of the mathematics school curriculum would be very familiar to these students. It is also a regular classroom practice to ask students to make posters about particular mathematical topics as a starting or ending point to a set of lessons about that topic. In addition, as mentioned earlier in the action research chapter, I had felt that some students made posters as a way of excusing themselves from sharing their story. I felt this was perfectly acceptable as I had made it clear that the whole process was entirely their choice. For the stated reasons, I did not include data that contained lists

of mathematical content, however if the content was linked with another aspect of the data it was included. An example of this is evident in the pilot study story called PhD, a small child is depicted as unhappy whilst her parents are helping her learn her times tables. In this story there is emotion connected to the action of learning mathematics with her parents, the topic featured in the story may be of importance and should not be discarded. I also did not include the drama as data simply because it was spontaneous and unexpected, and as such it was not recorded in any way. The content was full of emotion and directed at the shortcomings of several mathematics teachers. I felt that it would be very difficult for me to re-tell this story accurately and therefore it has not been included as data.

Asking the students to share their stories about mathematics proved to be a fairly simple part of the data collection. The stories were produced readily by the students and they appeared to enjoy the process. I felt very keen to read the stories, and in the pilot phase of this research I looked at every story immediately after the event. I shared some of the surprises with a colleague and a critical friend. They offered their interpretations of the stories (appendix E). I wrote what I saw in the stories with the intention of revisiting each story again with a new lens. I think what stopped me in my tracks was a growing awareness of my limitations as a researcher. Firstly, the fact that I could not enter the young story teller's world and hear the story as it was written. I was aware that I would only recognise things that I know about – I could only see things that exist in my own world and it was for this reason that I used a thematic analysis method and a question framework to revisit the stories more than once.

Secondly, the most profound thing about reading the stories was the way it altered my relationship with the student author. I could never see that class/student/young person in the same way. It completely enhanced how I planned the lessons with that student and the thought I gave to individual interactions and conversation with that student or group of students. I began to realise that this was a very important part of the data and needed to be written down while it was current.

My research experience during the pilot helped shape my future data collection plans. I now knew that I needed to build into the process an opportunity for the authors to tell me more about the story and any thoughts they had about taking part in the storytelling workshop. Whilst engrossed in the process of a thematic analysis I began to realise that within the analysis I had lost something important. Up to that point I had failed to appreciate that for my research to be successful it would need to address three audiences: the academic; my profession and myself. The thematic analysis process had provided a stimulus for the first two audiences but had moved away from satisfying my personal needs and values. Reducing the stories made me feel flat and empty; I had lost my view of the bigger picture which was the individuality of the student. This helped me to appreciate a problem that I felt could potentially be faced by students learning mathematics, and this was where does the 'self' fit? How can you bring the 'self' into the learning of mathematics and feel comfortable? Where in the learning of school mathematics can you insert your culture, history, personality, and aspirations? In a nutshell, how can a school student bring a bit of themselves into the learning of mathematics?

My thoughts around this question led me to consider some of the other subjects taught at school. I could appreciate that some subjects (for example, English, History, Geography, Sociology and Religion), naturally encourage you to explore the

‘self’ and lend themselves to thinking about our origins and connections. Mathematics makes little room for these connections and the expert language that surrounds this subject makes communication, for all but the most mathematically able, particularly difficult. I began to understand that asking a student to share their mathematical stories gives the student a medium to explore themselves within the world of learning mathematics, and the particular value of this process is an area that I felt I needed to develop further and should feature in my data analysis.

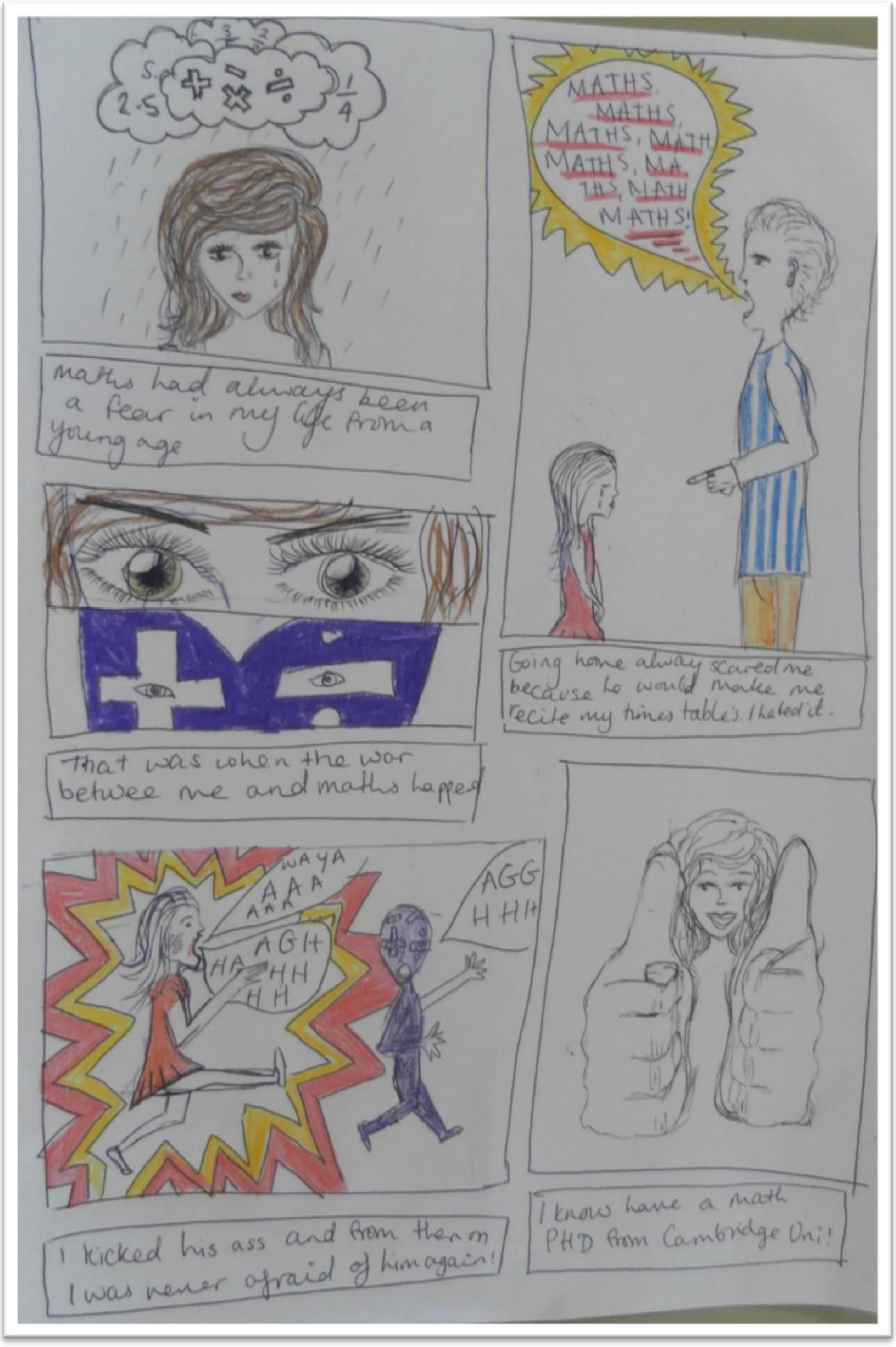
7.9 The Transformational Draw of Student Stories about School Mathematics

Once the work on themes was completed, I started to focus on the emotional impact that the stories were having on me, their reader. I felt that this emotional draw stimulated a powerful, transformational process that could help address my original research question: How can I create a more approachable and effective interface between mathematics teachers and their students?

The participants that took part in the pilot phase were not students that I knew well. I had stepped in as their mathematics teacher because they had been taught by a number of temporary teachers who felt that the class behaviour was too difficult and hence could not continue with them. Each story in this phase was put together by a group of participants, and it is safe for me to say that I had no pre-relationship with the participants which would influence my reading of the story. I did not know which particular students contributed to a particular story. Straight after reading the stories I made notes in my diary which I now include as analysis notes because I feel it demonstrates the potential student stories have for transformational thinking and forging relationships between student and teacher. The following section contains a

sample of three stories taken from the pilot stage of this research and my notes with regard to analysis. The notes were stimulated by my initial reactions and then by considering the questions that I had put together from a symbolic interactionist perspective (page 131). They have been used as examples to highlight the emotions and possible messages contained in the stories, and how they influenced the way I thought about the students in this class. This work was part of an early developmental stage of analysis and it was the foundations for what I now know as an intuitive inquiry approach to data analysis. In addition to my own analysis, I was assisted by two colleagues interested in the idea of storytelling as a tool for the mathematics classroom, they wrote down some brief first impressions of what they thought the stories were portraying and I used these to compare and critique with my own thoughts and ideas. An outline of their findings will be included at the end. Although the stories were put together by groups of students, to simplify the writing process I have referred to the story as having one author.

7.91 My Field Notes on Student Story Pilot Phase: PhD



During my first read of this story I was attracted by the articulate presentation of this student's relationship with mathematics. I could connect easily with the emotions depicted in the story and the passion and determination to succeed. The story was written by year 9 students in the first term of that year and they are thirteen years old. On the very first read of a student's mathematical stories an analysis began, it was intuitive, using tacit knowledge, and it drew on the context of the world that I exist in. The story is a good example of narrative as a multiple representation. It uses picture as a powerful device to convey emotion and feelings, yet when needed supplies just enough text to narrow the possible interpretations. It is temporal, it has a 'past' signified in the text below the first picture and the tense used in some of the text; a 'now' implied by the dealing with the enemy mathematics; and a 'future' of success with a PhD.

The story starts with the head and shoulders of a girl. In the speech type clouds there are symbols of mathematics suggesting to me a number of options within the context that I understand. Possible interpretations are; she knows a lot of mathematics, she thinks a lot about mathematics, she is doing mathematics or mathematics is on her mind. The inclusion of the head and shoulders in the image is said by Kress and Leeuwen (1996) to signify intent by the author to suggest a relationship, perhaps between viewer and author, or between author and mathematics. To me this provides possible evidence that this student cares about her relationship with the subject in question, (mathematics). The story 'as a phenomenon', particularly featured during my analysis of student stories. Each reading of the story brought with it new insights. In addition, my tacit understanding and my reaction to the story continued to develop as I taught that class. The story

took on new shape and contour as I started to understand my students a little better. This example of a student story illustrates the work of Kress and Leeuwen (1996:114), particularly their discussion of visual images. The girl in the picture is the 'represented participant' (the people, the places and things depicted in images). The author (the student) and the reader (me, the teacher) are the 'interactive participants' (the people who communicate with each other).The power of the picture is in my reaction to the represented participant, the author has provided the text to give clarity to the reason for the represented participants status. In this case it is fear of mathematics, and the choice of words is to impress on the reader that there is a history involved – a bigger picture. Using the student story as an example of narrative in action I found it impossible not to form conjectures about the student story, so immediately I have entered into a relationship. The first is with the people place and things depicted in the image, the 'represented participants' (Kress and Leeuwen, 1996:115), and the second is with the author of the story, the 'interactive participant'. This student immediately carved a new place in my capacity to understand my students, they now have more contour, more colour, and more depth, adding to the portraiture profile that I am continually building as classroom teacher.

The girl has a sad face, she is not making eye contact with the reader, and her eyes are slightly lowered. There are tears coming from her eye and rain coming from the speech-like clouds. I have a shared understanding of these symbols – upset, sadness, disappointment, worry, anguish, despair. I ask myself what could cause this sadness; is it about mathematics in general or about school mathematics experiences? I worry that it might be closer to home, is it about my lessons and my delivery of mathematics? Perhaps is it more personal and about herself? The author clarifies the situation with a small amount of text; she has a fear of mathematics. The

picture is powerful and quickly conveys a multitude of things, the text then gives me guidance as to which of the contexts above could be relevant. The range of explanations that can be applied to this student stories reminds me that there is no certainty in narrative research. Bold (2012) explained that there is no aim to establish certainty but to apply tentativeness due to the different interpretations that are possible.

The second picture shows the girl with a man, the text informs us that she is in her home; the man is possibly her father or a male relative. She is sad and small, and the man is tall and appears strong. We get the impression that he is shouting (indicated by the writing in the speech clouds and a wide open mouth), he is in authority and he is going through her maths with her. The girl has depicted herself as small and passive, she is crying and her body language portrays a meek compliant stance. The man appears to be in charge and someone to be taken notice of, but the girl is 'scared' of the encounters with the man and mathematics, she hates it! What occurs to me is that the picture can be seen as symbolising the traditional view of mathematics, the pupil is seen as the passive object and the mathematics is transmitted, simply told to the student, and if told enough times it will be absorbed.

The third picture transmits to me the relationship the girl holds with mathematics. There are interactions between the girl and mathematics and it seems that the relationship between them is represented by their relative size. Mathematics as an object is initially portrayed as strong and confrontational; the size of mathematics eyes seems large and powerful. She is making a connection with her eyes to signify an emotion, the person 'mathematics' is returning the look. This girl is not accepting her position in this world of mathematics; she is going to battle with mathematics and

overcome her fears. Mathematics is the enemy! This girl is depicted as aggressive, strong and bigger than the mathematics. Later on mathematics is smaller than the girl, it is now frightened and being chased away. There appear to be a suggestion of some social norms for this student, one is a link between mathematics and negative feelings, another is a reference to pressure from others in the story. She indicates that an action linked with mathematics is learning her tables at home with her parents. The story develops into a confrontation with mathematics and then fighting, the girl is the victor and mathematics flees. Perhaps she believes that you must stand up for yourself if you want to be successful. The story is full of emotion and feelings: fear; sadness; confusion; feeling small and inadequate; determination (perhaps stubborn); anger; strength; happiness and pride.

The girl is a social object in this story, she is a mathematics student and she changes her appearance depending on her positioning in this story, I think this may be linked with how she feels about mathematics in those encounters. Mathematics can also be viewed as an object. The girl depicts mathematics as a person and as such I can consider it as a social object that is making her life miserable, she portrays herself as sad and scared.

If I consider the development of self within the context of mathematics then there is a growing sense of strength in the story, the girl is overcoming her fears by overcoming this mathematics. Clearly it is a battle, and she has to fight hard, but she makes the maths retreat, run away. A PHD from Cambridge is her successful goal, which indicates to me that she is ambitious, stating a high qualification and a very

reputable institution, yet there is no sense that she ever accepts or befriends mathematics, or becomes at ease with it. The last picture portraying her success gives me the impression that it is about pleasing herself and perhaps her father, in this she has become a scholar in mathematics and we get the thumbs up.

The story highlighted some things that I find personally interesting; this interest could potentially be seen as bias which can be considered as just noticing things that suit you. The justification for my interest is that I am noticing things that have featured in my literature search pertaining to mathematics. From an intuitive inquiry standpoint I can openly examine these areas as data that can best addresses my research interests, 'Follow your enthusiasm and initiative; notice what attracts your attention again and again' (Anderson, 2011:253). I found myself dwelling on several areas in this story, one area of interest was the way the student represented mathematics, and another was the way the student described her interaction with this object. Later this interest developed into the themes which I called the faces of mathematics, power and status of mathematics and the culture of mathematics.

In my role as a mathematics teacher, the power of the student story is the fact that it brings the student quickly into my focus as an individual, with a history and an experience that is unique. The process of content analysis lost the temporal nature of the stories and encouraged me to adopt a 'one size fits all' mentality; an approach that I feel is inappropriate for the nature of this data and hence was rejected as an adequate form of analysis for this research. To help me gauge the reliability of my

interpretation of some of the stories I asked a colleague to share their interpretation, these are the notes made about the story PhD.

> Colleague comments
>
> Always found maths hard, fearful upsetting. All jumbled together and nothing made sense. 'From a young age' shows never had good experiences of mathematics. Maths is like rain pouring down from the clouds.
>
> Her father at home not being supportive and making student recite times tables over and over again. Being scared of going home because of the maths that would be waiting. Now hating maths.
>
> The war between the student and teacher happened. The student attacked maths and found that in spite of the teacher she was beginning to understand and was no longer afraid. This meant her understanding grew and she felt much happier.
>
> Very successful in the future, achieving a maths PHD from Cambridge. Shows that all obstacles can be overcome and the boundaries no longer exist.
>
> Views of mathematics are changing, no longer feels scared and upset. Now feels it is possible to achieve and to reach great highs in the future with a subject that at first was not a happy experience

These comments from my colleague supported my interpretation of the story and I felt encouraged that my initial instincts about the story were credible.

7.92 Pilot Phase: The Real Story of Cinderella and Snow White

(The story below is typed as a copy of a student's story but I have corrected some of the spellings.)

> Long, long ago in a small town called Maths land lived a very good mathematic called Snow White. But also at the other end lived a very poor girl called Cinderella, who was terrible at Maths, but always tried.
>
> It was the night of the ball and Snow White and Cinderella was getting ready. They both were in love with the Prince Charming. But they know that he would like a wife who was very good at maths seeing as he was a professor.

> They both arrived in their motor-autos to be greeted by the Prince Charming, who said that one of them would be his wife by the end of the night. But they would be judged by their ability of Maths.
>
> Snow white knew this was so easy, but Cinderella had a feeling that the mission was going to be hard.
>
> He asked them in the story of Cinderella what was the time she had to be home. Cinderella knew this because she was reading earlier and she answered 12 o'clock. They lived happily ever after.
>
> The moral of this story is that the best mathematic is not the one who gets all the grades. But it is the one who thinks properly and has got good knowledge. And revises and always contributes.

On the first reading of this story I was surprised at what it seemed to be saying to me. It was as though, to me, this student was representing society through this story and I felt that they story had a moral linked with fairness and freedom. I was drawn to the work of Gates (2004) who argued that mathematics acts as a gatekeeper, allowing access to higher education and careers for those who are successful in national mathematics examinations, and blocking the path of others who cannot meet those standards. My first reading of the story led to this diary entry:

7.93 My Diary Extract

> *This story has taken me by surprise. For me it contains massive cultural assumptions and maybe I see them because I have biases resulting from a working class, essentially immigrant, background. Others will need to be the judge of how ridiculous my interpretation is or is not, but this is what I see.*
>
> *The heroine Snow White is good at mathematics but poor Cinderella is terrible at mathematics. For me this is symbolic of the thinking that the upper class, rich, and successful are good at mathematics, whereas the poorer classes, less privileged are not. For the more fortunate upper class, things are easy and life is good but for the poorer classes they have to work hard to succeed (Cinderella always tries her best). Snow White enters the contest with confidence, and Cinderella knows that she may struggle.*
>
> *Prince Charming, being a royal the most elite of all, he is obviously well educated because he is a professor, and being so, he obviously needs an intelligent, educated wife, which in this story is measured as being good at mathematics.*

> *Snow White and Cinderella are in competition. One is perceived as good at maths (a mathematician), the other is not. The competition goal is focused on one event, the ball. Only one person can win, technically the 'clever one' portrayed as the person good at maths, this person will be the desired one.*
>
> *So mathematics is portrayed as the gate keeper in this story. Mathematics is the decider for the future of Cinderella and snow White. Fortunately, for the satisfaction of my beliefs, the story is used to promote effort and preparation so Cinderella wins the prince.*

After several reads I applied the list of compiled questions and made the related notes. I cannot help feeling that there is an analogy to ability setting in class somewhere in this. The ball feels a bit like an examination because it is there that decisions and judgements will be made.

Looking at the social aspect of the story, we have the authority (the prince) who is male and making the judgements, and we have the subjects, two females in competition for a place in the world of the prince. Mathematics is portrayed in this story as a means of measuring, mathematics ability seems to be something that belongs to the rich and famous yet it is recognised that mathematics success is portrayed as something that has to be worked at and earned. I think this story portrays a person, (the author), who wants the reader to sit back and withhold any judgements pertaining to her ability. This student recognises that hard work and revision has credit in the world of mathematics and can get you results that others do not expect. They have the inner strength to know that they are able to be successful in this arena if they are allowed to have the time to develop and work hard. However they measure success by winning, being above others.

7.94 Phase 1 Pilot: Keep Trying

This story attracted me for a number of reasons. I was captured by the sentiment- this student really wanted to do well in mathematics but was frustrated and upset

with examination results. The use of cloud and sun to depict classroom environment and what looks like her parents telling her off made me feel sad that she has to endure these scenes. Then the word failure hits the spot and I ask myself if this is really the way we make our mathematics students feel. Algebra is shown in the pictures, and I wonder if the author is trying to show that mathematics can be complex and that she is struggling to reach that area of complexity. The story gives a strong image of a mathematics classroom with a girl sitting on her own raising her hand to answer a question; the teacher is at the front teaching from the board. I sense that the student wants to do well in mathematics tests and understands that she has to make the effort to revise. The end of the story brings it all together and makes it all worthwhile, perseverance, hard work and effort make good in the end and the student gets her desired exam results.

Colleague comments

Shows a very confused student with lots of questions going round in their head.

Needs to sit an exam on algebra. Can't answer the questions so frustrated that she breaks her pencil in half. Lots of confusion everything on the paper just seems a jumble.

Other students in the class happy with their results, 100% and 85% being passes. Both papers have large ticks on them. She on the other hand gets 12% and fails. Paper has a large cross on it. She is very upset, there seems to be a big black cloud over her, she is crying, also lightening present this could be her anger at not being able to get a good score.

And so it carries on. She cannot shake the black mood, things do not seem to improve. Other students in the class understand what the teacher is saying but she does not. She does not put her hand up, either to answer a question or to ask for help. Interesting to see the child who understands is smiling and has a sun over her head.

Looks like three children are being shouted at by their parents. The youngest is crying but none of them seem to be happy. The student feels like an absolute failure. She is lying on her bed crying.

She tries really hard. She revises, then revises, then revises some more. Each time she tries the test her grades improve, 40%, 70% and lastly

100%. The smile on the face grows as the grade improve. The moral of the story is keep trying no matter how hard you are finding things.

This story board is very specific to algebra maybe this is a topic this student found hard to understand, but with practice and perseverance they got better and better.

The student stories provoke me to consider all aspects of my classroom practice. I found myself interrogating my use of language and the inferences that could be taken from the words I use. Because the stories had been written by groups of students, it was impossible for me to address an individual student's needs in terms of this research and I felt that perhaps this was a missed opportunity. However, there were some general points that I could tailor my practice to address, these were: the student's view of tests, their negativity when doing mathematics and generally their expectations of 'doing' school mathematics. Although tests had to be part of my teaching plan I now knew that I would need to enter into individual and class discussions about the place of tests and what they show. Once I had read the student stories I felt that, as a class, we had to develop an ethos about progress that would help these students move forward. In response to that, an area that I focused on in this class was the concept of progress in mathematics. I talked to each student about individual progress and I asked them to set themselves small incremental targets that they would use as their focus when considering test results. For each student I discussed and assigned targets such as showing clear steps of working when answering a question, legible work, time management in tests, improving numeracy strategies and mathematical vocabulary and language. When feeding back to the student my focus was on progress and their achievements with respect to meeting their target. By doing this I was focusing on the quality of the work and student learning, which does not over -ride the test result, but helped the student feel achievement for something other than a test score. We also talked about test

scores and individual progress measured from the student's last test score, schools often refer to this as value added scores. My philosophy about progress in a test is that anything that can be seen as improving is considered as progress and eventually all these small increments of progress fit together to make a tipping point (Gladwell, 2000), a point when something transformational happens. This class worked with this ethos and at the end of the school year many students received their exam results with excitement and large smiles.

Another aspect of the stories that kept haunting me was the reference to being unhappy or uncomfortable while taking part in mathematics lessons. It made me actively seek different types of lesson that could be slotted into the curriculum on a regular basis without deviating too far from the scheme of work. Developing thinking skills and group work became the theme for this part of the mathematics curriculum and many of the very successful lessons were then by my colleagues in their own classrooms. Over a period of months this class changed from an angry bunch of teenagers into a relaxed, interesting, vibrant group of learners, who could discuss their mathematics, their progress throughout the year and engage in a variety of learning environments.

The one point that I think the reader will, or should, ask is whether the change in the class happened because of the stories. The stories helped me to focus an intervention on the areas that were crucial to the progress of the class, they filled in the gaps that explained the class attitude towards me and their previous mathematics teachers, they invited me to hold back on behaviours that I might have

used without the stories and for me, they turned what was in my eyes as a collective angry class, into a set of individual people with specific needs.

7.95 Conclusion

The success of the mathematics story workshop, and the knowledge that I gained from the process, the content of the stories and the subsequent development of a student and teacher relationship led to the development of the next phase of this research. I felt that individual stories, shared by mathematics learners that were finding school mathematics a struggle could potentially be a very effective tool to address my second research question which was: How can I create a more approachable and effective interface between mathematics teachers and their students? I decided in the next phase to build on the analysis techniques already employed but also to explore how the stories changed my understanding of the students in the class and my subsequent interactions with them. Towards the end of the pilot phase I discovered literature that started to allow me to accept my varied analysis techniques as a planned design. Intuitive inquiry analysis (Anderson, 2011) celebrated using a variety of analysis techniques; Anderson (2011) also suggested that this variety helps to promote thought, improve rigour, expose surprises and potential bias and generally helps the researcher to look at data from points of view that are not necessarily ones that they would readily lean to.

In the next chapter I give a descriptive account of how the data analysis proceeded and the influence it had on my understanding of the students and classroom practice with those students.

Chapter 8 Data Analysis: Phase 2 and 3

8.1 Introduction

After completing my data collection for phase 2 and phase 3 I had a variety of data types. The data consisted of 35 student stories, two student interviews about the storytelling workshop, my diary extracts, written feedback from a colleague regarding her interpretation of the stories and a recorded discussion with a colleague who carried out the storytelling workshop. My aim for a data analysis was to include all data types in my overall impressions and outcomes, and communicate to the reader the powerful effect on me that reading the stories had induced.

8.2 Step One Intuitive Inquiry Model

The first step of the intuitive inquiry process had been the pilot phase of this research where the student stories became the selected texts that could be examined to gain information and an understanding of the experiences of my students when learning school mathematics.

8.21 Step Two Intuitive Inquiry Model

Using the literature that I had previously read and actively seeking new material I constructed my understanding of the themed headings from phase 1 pilot phase by entering into a critical reflection on what had been written by other authors. This is represented in chapter 2 which deals with my literature search pertinent to my themes from the phase 1 data analysis.

8.22 Step Three: Intuitive Inquiry Model

For step three of the intuitive analysis process, I chose my 264sample and carried out the storytelling workshops with this sample. The data collected included stories from my students, stories from the classroom of colleagues and my intuitive insights in the form of a diary. The rationale for selection, organisation and field notes for these stories was discussed in chapter four phases 2 and 3, which explains how the action research process evolved and developed.

8.23 Step Four: Intuitive Inquiry Model

Entering to step 4 of my intuitive inquiry model was an enormous step. The data consisted of 35 stories from the students that I taught and feedback from two colleagues who trialled the storytelling workshop with their classes. The storytelling workshops covered three phases of the action research cycle as explained in chapter 4. I sorted the stories into groups; these were class groups and year groups. Each story was given a category which described the type of story; the headings I allocated were personal narrative, story board, fairy tale or poster. I also indicated whether the main body of the story seemed, to me, either positive or negative. I felt that sorting the data in this way would help me to notice patterns and things that were particular to the class or year group, thus allowing me to decide if these things were general findings pertinent to the research. In addition, my reactions, thoughts and feelings about the stories became part of the data alongside my subsequent relationship and interaction with the storytellers. To help provide a different perspective I asked a colleague to look at a selection of the stories and record her comments.

8.3 Phase 2 and 3 Student Stories

Two classes took part in the phase 2 data collection process and I coded their stories AaH11 (A) and BaF11 (B) to help me distinguish the groups at a later date. I have decided to keep the coding algorithm personal for the protection of anonymity. In both classes there was a mix of individual work, pair work and group work and, if I have that information, it is included in the table.

Group A produced nine finished stories and two unfinished stories (due to some students missing workshop time). I have given each story a title based the content of their story. I labelled each story with either N (negative), P (positive), or F (neither positive or negative) according to their reference about mathematics taken from the main images or the main body of the story. Originally, I gave stories with a happy ending a positive label but later decided that as a happy ending was a natural form for a fairy tale I should use the main body of the story to make a judgement. I also gave them a category of narrative if the text told a connected story, story board for a series of images, personal if the story was possibly about them, fairy tale if the format conformed with that of a standard fairy tale and, poster if the content was a list of things. I asked a colleague to do a similar exercise to add validity to my labelling. Phase 2 stories can be seen in appendix H.

Figure 6a: Phase 2 Data One

Title		Type	No of students working on the story
Changes in maths	F	Personal narrative	Group
Cinderella	N	Fairy tale narrative	
Clown	N	Personal narrative	Individual
Crying	N	Story board/ personal	
Faces	F	Story board /personal	Pair
Formulas	N	Poster	
I love	P	Personal narrative	
Mathematics	P	Poster	Pair
On beyond a million	P	Personal narrative	Individual

The unfinished work was ‘snakes and ladders’ and the ‘door to success and failure’. I did hope that these students would get some time to finish but it never happened and in hindsight if the workshop had taken place earlier in the term we could have found the time. The second group B produced seven stories. Two students chose not to take part and asked if they could work on their mathematics instead. These students stayed in the classroom while the workshops were taking place. They took an interest in the stories that were being created but continued with their mathematics work, asking me for input when they needed it.

Figure 6b: Phase 2 Data Two

Title		Type	No of students working on story
Coloured Squares	N	Personal narrative	
Girl's maths madness	N	Personal narrative	Individual
Jessica's maths story	P	Personal narrative	Individual
My maths experience	P	Story board personal	
The boy who found confidence in maths	P	Personal narrative	Group
The letter with the maths grades	P	Personal narrative	Individual
Whiz kid	P	Personal narrative	

The table below shows the labelling over the two groups

AaB11 9 stories	Positive	Negative	Neutral	BaF11 7 stories	Positive	Negative	Neutral
4 personal narrative	2	1	1	6 personal narrative	4	2	0
1 fairy-tale	0	1	0	1 story board/personal	1	0	0
1poster/ personal	0	1	0				
2 story board/ personal	0	1	1				
1 posters	0	0	1				

The first set of students (phase 2) were students aged fifteen and sixteen, in their final year of preparing for GCSE exams. The class AaB11 were described by the school as a borderline class, meaning they were on the border to getting a C grade at GCSE. They would be entered for a higher paper in GCSE maths, and during the last two years they had been studying topics that were tested on the higher GCSE

paper. They second group were also called a borderline group but their assessments to date had indicated that they were weaker mathematically than the first group. During the last two years they had studied many topics that were particularly targeted at the foundation GCSE grade.

The participants of phase 3 were students age 13 and 14. These groups were also targeted as groups that needed particular intervention in mathematics as they were underperforming. My data analysis process took three distinct forms. For the first I explored the themes produced in phase 1 using extracts from the student stories to support and add clarity to these themes. By using a process of thematic analysis and input from colleagues, I examined the stories to see how they support or contradict the themes developed during the pilot phase. The second form of data analysis highlighted a selection of the stories that caught my attention because they surprised me. I have attempted to communicate my thinking about the surprise in the following sections and how this new knowledge influenced my subsequent work with the student, but in the spirit of an intuitive inquiry approach these are stories that identified with my research interests addressing positivity or negativity and struggle in mathematics. The third form is a report on the storytelling workshops of colleagues, focusing on the workshop as a classroom tool for mathematics teachers and feeding back the opinion of the staff facilitating these workshops.

8.31 Data Analysis: Themes

The themes arrived at in phase 1 were as follows: The faces of mathematics, the classroom culture of school mathematics, freedom, the power and status of mathematics, and relationships. However, while the next data collection was in

process, my thematic analysis continued with the original data, new data and input from colleagues, and eventually two particular themes stood out across the stories and the different data inputs. Across the three phases of data there were very common themes such as transition in mathematics and mathematics changing with time, status, and a lack of freedom associated with being trapped and not belonging. However, the more I played with the data, the more it seemed that these topics were intrinsically linked with how a student viewed mathematics and should be a subset of the theme that I had named 'the faces of mathematics'. Stories that contained a reference to exam results and teacher behaviour were also common across the data set and again I felt that these were all part of the culture of learning mathematics in school. With this in mind I settled on two main themes: the first I still called the faces of mathematics and the second was called the culture of school mathematics.

8.32 Phase 2: The Faces of Mathematics

Many of the stories treated mathematics as if it had human characteristics, others referred to how they felt when they were learning mathematics. I used spider diagrams to organise many of the ideas about mathematics presented in the stories and made links between related ideas. I began to think that the heading of different groups should be simply Maths is …… and then within this I could list the phase 2 stories that I think refer to maths as this. My original headings were Maths is powerful, Maths is measurement, Maths is nice, Maths is not nice and Maths is changeable. With the story content that was not placed in these themes I regrouped repeatedly and then included two more themes which were Maths is useful and Maths is challenging. Other groups that appeared came under the heading of how you do mathematics and that will feature in the category called the culture of

mathematics. In the table below I have listed the stories in phase 2 that make reference to these themes.

Figure 7: The Faces of Mathematics.

Maths is powerful	Maths is measure-ment	Maths is nice	Maths is not nice	Maths is useful	Maths is challenging	Maths is changeable
Does something to you, influences you	*Rank, status, result, position*	*Makes you feel good, happy etc*	*Makes you feel unhappy, sad etc*	*Can be used, gets you something*	*References to cognition, thinking etc.*	*Changes with time or situation*
A clown A Cinderella A I love.... B My maths experience	A clown A I Love ... A Crying B Girl s maths madness B Jessica maths story B My maths experiences B the letter with the bad grade	A I love… A On beyond a million A mathematics A Faces B coloured squares B Girls maths madness B Jessica's story B Whiz Kid	A Cinderella A Clown A Faces B Jessica's story B My maths experience B the boy who found maths	A Cinderella	A Cinderella A Clown B Coloured squares	A Changes in maths A I love… B Coloured squares B Girls maths madness B Jessica's story B My maths experience B The letter with the bad grade

8.33 Maths is Powerful

Maths is powerful refers to the idea that mathematics can influence you or your actions. Below are some related extracts from the student stories:

> (A Clown)
>
> He stares me in the eyes, mocking me on his white background. My heart skips a beat, intimidated by his bold writing. …….I take all I can

from him leaving him powerless and completely worked out. With his power adding to my score, I then turn the page and go on to his brother.

(Cinderella)

Cinderella was stuck in her boring maths class

(I love….)

Maths is getting tricky but I can't be picky

Algebra can be described by the sound of my sigh

8.34 Maths is Measurement

Maths is measurement refers to the idea that mathematics can rank you, give you a number or a position amongst your peers, measure you against some institutional scale.

(Clown)

I slowly put my pen to paper and begin to write my only wish to please him and take the marks wrapped up in him and add them to my score.

(I love…)

Picture with sats levels

SATs are coming but I won't be running

They need to be done to show I have won!

(Crying)

I won many medals from silver to bronze on the day of graduation… I remember arriving at academic review day in year 10 and seeing an A grade on my report card.

Mathematics) – bottom half of poster

(Girl's maths madness)

Layla went from a higher to a foundation student.

Layla did many maths exams but never got the C for foundation.

She tried and tried and when she went in for results day she knew that she had failed, but she passed, the hard work had paid off.

(Jessica's story)

So she didn't try so she failed but the following year the last year, year 11, she suddenly grasped the technique, skill and revised pattern needed to be successful in maths and she hopeful will pass her GCSEs and have her C or more in maths.

(My Maths experience)

Pictures plus caption

(The letter with the bad grade)

Getting the results of my maths exam that morning changed everything. The minute I opened the envelope I could taste disappointment…; I was 6 months away from finishing school, it seemed impossible to achieve good grades.

8.35 Maths is Changeable

Maths is changeable was a theme that I was particularly fascinated by. It seems to take a variety of forms so the extracts below are made up of: a) mathematics seeming to be a different subject over a period of time: b) mathematics being good or nice then mathematics being unpleasant or not nice: c) changing whether you like or dislike mathematics and d) changing if you are good or not good at mathematics. Interestingly, with the exception of the first story, the stories below are all from the B group of students. As these students did not work together this result caught my attention and encouraged me to consider why this had occurred.

(Changes in maths)

<u>Video transcript (made in private)</u>

This is my story about, um, how maths changes, um, from primary school to secondary school. And on primary school it's got like the division signs and the times signs and the times tables and how to do division, and in secondary school it's got a squared plus b squared equals c squared and cos and sine rule and stuff.

(Coloured squares)

> When I got to secondary school, my love for maths wasn't as strong as adding and subtracting and multiplying and dividing turned into things like algebra and Pythagoras theorem.
>
> (Girls maths madness)
>
> When Layla went to secondary school she was quite bright from year 7 – year 9. As soon as she started year 10 she slowly started to lose her knowledge in maths. Layla went from a higher to a foundation student
>
> (Jessica's story)
>
> Year 2 was the year were it all clicked, she realised that when you listen to the teachers instruction and actually practice it, life, school, maths became so much better for Jessica. She began to love Maths. Year 4 was when she lost her new found love for maths. The reason was because she didn't want to challenge herself and improve but Jessica wanted to stick to what she knows because she did not want to be reminded of my first year.
>
> (My maths experience)
>
> The first two pictures show a change in maths. The first shows a student with coloured blocks and indicates maths lessons were easy. The second picture shows a student with paper in front of them and states maths is harder than last year.
>
> (The letter with the bad grade)
>
> Maths was the best subject when I was younger but everything changed. It became a challenge, something I couldn't cope with. Every topic seemed hard algebra, equations, Pythagoras, shapes, angles, finding volumes etc.

The thematic analysis produced some very interesting ideas relating to how these students thought about mathematics and learning mathematics. This gave me much food for thought about how a mathematics department could develop and grow with current student views and opinions. However, the process felt a little clinical and disconnected, I felt that by dismantling the stories I had lost the essence of the data, and by association I had lost the student as a person. The methodology of asking the students to share their stories was designed to allow them voice, uniqueness, differentiation and comfort. I knew that I had to find a way to allow these traits to feature through my data analysis; I could feel, in that sort of embodied way, that thematic analysis was not doing the stories, or their author, justice. While reading

some of the stories, I started to get an emerging impression of the plot that was not being represented through the thematic analysis, that the whole story was greater than the sum of its parts. I attributed this phenomenon to the relationship that was developing between the story, its author and the reader.

8.4 The Culture of School Mathematics

Figure 8: The Culture of School Mathematics

The teacher	Transition	Learning mathematics	Relationship with peers or others	Exams and assessment	Perceptions of self
Teacher influence and relationship with student	*Changes in mathematics to do with changes in school, class, teacher or experience*	*How maths is taught and learnt*	*Others in the class and school, family*	*Results, status, preparation and emotions*	*How you think you fit in a mathematical world, comments on ability and relating to self-reflection.*
A On beyond a million B Layla B Jessicas maths story B My maths experience B The boy who found confidence in maths	A On beyond a million A Changes in maths A I Love B Coloured squares B Jessicas math's story B My maths experience B The letter with the bad grade B Whizkid	A On beyond a million A Clown A Changes in maths A Cinderella A Crying A I love B Coloured squares B Layla B Jessicas math's story B My maths experience B The boy who found confidence in maths B The letter with the bad grade B Whizkid	A On beyond a million A Cinderella B Layla B My maths experience B The letter with the bad grade	A On beyond a million A Clown A Crying B Layla B Jessicas math's story B My maths experience B The letter with the bad grade	A On beyond a million A Clown A Crying A Coloured squares A Mathematics A I love B Coloured squares B Jessicas math's story B My maths experience B The letter with the bad grade B Whizkid

8.41 The Teacher

This refers to references made about any mathematics teacher, teaching assistants or tutors. The pilot phase stories had made specific reference to teacher behaviour and change of teacher, the students here connected these to their learning and how they felt when doing mathematics. They were angry stories full of emotion. The phase 2 stories portray teachers as people that help you although two stories mention teacher behaviour. Again as in phase 1 there is indication that the students do not like teachers shouting.

> *(On Beyond a Million)*
>
> *My teacher is great as she helped throughout the three years I was at school and she continues to help me so that I can finish my GCSE's and get an A.*
>
> *(Layla)*
>
> *She attempted to learn in the maths classes but she struggled because she had a bigger class with two teachers. When Layla asked for help the teachers helped her.*
>
> *(Jessica's Maths Story)*
>
> *And with the TA's shouting and nagging at her she just stopped trying.*
>
> *(My Maths Experience)*
>
> *…. she realised that when you listen to the teachers instruction and actually practice it, life, school, maths became so much better for Jessica.*
>
> *(The Boy who found Confidence in Maths)*
>
> *Two pictures feature teachers, one depicts a student being told off for not listening and the other is a teacher giving back work to the student and has a similar caption as the first, saying I didn't pay attention in class. Until one day his teacher told him about a website called 'Manga High'. The teacher said it would prove to be very useful and a fun way of learning maths.*

8.42 Transition

This refers to changes of school, class or teacher. The stories indicate that the transition from primary school to secondary school can be the catalyst for students turning away from the subject because they find the mathematics different and difficult.

> *(On Beyond a Million)*
>
> *When I came to England in 2007 in August I went to two different schools. Maths in England is different from maths in Pakistan. We are taught different methods.*
>
> *(Changes in Maths)*
>
> *This is my story about, um, how maths changes, um, from primary school to secondary school. And on primary school it's got like the division signs and the times signs and the times tables and how to do division, and in secondary school it's got a squared plus b squared equals c squared and cos and sine rule and stuff. So, what I think is, that it's fairly confusing from this stage to that stage, because one minute(laughs) you are all happy because it is quite easy and then you come into year 7, year 8 and year 9 and you have to learn algebra and statistics and everything and it's a bit hard.*
>
> *(Coloured Squares)*
>
> *When I got to secondary school, my love for maths wasn't as strong as adding and subtracting and multiplying and dividing turned into things like algebra and Pythagoras theorem.*
>
> *Jessica's Maths Story works its way through the year group commenting on the differences.*

8.43 Learning Mathematics

This includes references made to curriculum, the manner of learning, and classroom practices.

(On Beyond a Million)

The methods which we used were different from the methods which we used in London. We are taught different methods. I have really enjoyed this experience as now I know how to do both of the methods.

(Clown)

… mocking me on his white background. My heart skips a beat, intimidated by his bold writing.

(Cinderella)

Cinderella was stuck in her boring maths class. This story mentions homework, struggle with algebra and her compass.

(I Love)

Maths was always a mission but I could do the division. Adding and subtracting is the easy way of acting.

(Coloured Squares)

was all about adding, subtracting and multiplying SMALL numbers. However, I was always bad at multiplying in maths.

(Layla)

There was a girl called Layla, when she was younger she really enjoyed mathematics. Every classwork that was handed out, Layla was the first one to complete it. Sometimes she didn't understand the work but carried on like she did.

(The Boy who found Confidence in Maths)

The boy hated maths. He didn't know his times tables nor did he know how to add fractions. Maths for the boy was a pain, especially maths lessons. The boy always worried about having the wrong answers.

The story below called my maths experiences, has pictorial descriptions of classroom practices in each frame.

8.44 Relationship with Peers or Others

There are clearly people other than the author in the student stories. In many the pictures show other students and teachers. Teachers are shown in a variety of relationship forms which include, being helpful and telling the student off. Other

students are present in stories but the relationships are not clear except when there is a school bully.

(Cinderella)

The school bully sees the compass that Cinderella dropped and hid it in the art room.

When Ardino met her in the library he managed to complete the homework and they lived happily ever after with the compass.

My Maths Experiences (pictured above) includes peers.

Layla story suggests that it is harder to learn with a bigger class size.

(The Letter with the Bad Grade)

My mother looked anxious about my future; I was 6 months away from finishing school, it seemed impossible to achieve good grades.

It was that moment she said it, 'I believe you will reach the aim of an amazing grade in maths but we have to work hard.'

My mother supported me all the way through my hard time with maths, we revised, put effort into my studies, got a maths tutor. Everything improved with time.

8.45 Exams and Assessment

Not surprisingly exams and grades feature in most stories. I would expect this as both classes are preparing for their GCSE exams.

(Jessica's Maths Story)

So by the time she got to year 10 it all became very real and she found it quite hard to adjust to the higher level more serious work. So she didn't try so she failed but the following year the last year, year 11, she suddenly grasped the technique, skill and revised patterns she needed to be successful in maths and she hopeful will pass her GCSEs and have her C or more in maths.

(The Boy who Found Confidence in Maths)

On the day of the maths exam the boy would sit there in the hall and stress about everything maths related.

(The Letter with the Bad Grade)

Getting the results of my maths exam that morning changed everything. The minute I opened the envelope I could taste disappointment. It was the day I found out my results, did the hard work pay off? Today was the day I was going to find out.

(On Beyond a Million)

……. She continues to help me so that I can finish my GCSE's and get an A.

8.46 Perceptions of Self

This refers to references made by students about themselves in relation to their mathematics learning.

(On Beyond a Million)

The feelings that I had towards maths whilst I was in Pakistan was really good but I found it a little hard, but maths was my favourite subject as I could use my brain

(Jessica's Maths Story)

Year 4 was when she lost her new found love for maths. The reason was because she didn't want to challenge herself and improve but Jessica wanted to stick to what she knows because she did not want to be reminded of my first year.

(Layla)

So she entered year 7, she practised what she learnt from primary and became very successful in year 7 maths but as she got to year 8 she fall back into her old way and became lazy and in year 9 she became even lazier and started seeing school in a new light, which didn't end very well. Layla did many maths exams but never got the C for foundation. She tried and tried and when she went in for results day she knew that she had failed, but she passed, the hard work had paid off.

(The Letter with the Bad Grade)

If the letter with the bad grade didn't come, I wouldn't have known what I am capable of doing, but the truth is anyone is capable of doing so.

8.5 Feedback from the Workshop of a Colleague

Two colleagues carried out the storytelling workshop with their year 11 class, the students were sixteen years old and just finishing their GCSE course. I asked my colleagues to feed back any thoughts to me and this was kept informal. The feedback about the management of carrying out the workshop was very positive and both colleagues said they found the stories interesting and informative. One colleague recorded her comments and impressions from the stories and I have included below, with her permission, the main points.

I asked one of these colleagues to take part in an informal style feedback talk on the storytelling workshop and the stories produced. With the agreement of my colleague we had the tape running so that our record of the conversation could be accurate.

The feedback from the running of the storytelling workshop was that all students wanted to take part, most of them worked in small groups and they seemed to enjoy the process. The class teacher said that she found the session interesting and enjoyable. Below I am going to feedback some main points that came out of the recorded informal feedback from the class teacher who I will refer to as colleague A.

Colleague A carried out the workshop with two classes, one higher set class that were producing very good mathematics results in assessments, and another class that would be described as a lower set class whose school mathematics targets were C and D grades. The students were in their last term of GCSE work and by the time we carried out this feedback they had finished their mathematics exam. Colleague A felt that carrying out the workshop with the higher set group was not so useful because most of the students communicated that mathematics was good and

that they were happy with the grades they were getting. Some stories also predicted a future that included mathematics and this was presented in most stories as being important, ‘my life depends on my A - level Maths’ (student story extract).

Two stories stood out as different, both mentioned the differing mathematical experience between primary and secondary school. ‘Maths was fun in primary school and it is not fun anymore’ (student story extract), and there were other indications that they worried about transitions in mathematics such as changing class or teacher. There were also indications that their mathematics experiences were changeable, ‘Maths can make you angry and can make you happy’ (student extract).

Colleague A said that she would find the stories particularly informative if she had them at the beginning of year 10 rather than at the end of year 11 because all stories contributed information about the student and her mathematics that could be very useful for future planning and classroom work.

One story that caught her attention had a section as follows:

> *My relationship with maths: -Maths to me is a load of numbers and rules that will not apply anywhere in life unless I become a mathematics teacher.*
>
> *Memories from when I was younger: - me sitting on carpet confused as a cow on Astroturf trying to figure out why I am here.*
>
> *The majority of time maths and me do not see eye to eye as I question the rules.*

Colleague A felt that the second set of stories were completely different and repeated again that if she had seen the stories at the start of the year she could have

addressed particular issues that are mentioned in the stories. Referring to the story telling workshop, colleague A said, ‘I think that it is good because it allows people who say nothing in class to have a voice’. She said that she would now like to build in to her curriculum work on the importance of mathematics and where it impacts on life outside of school, and incorporate into the planning other tasks designed to raise the self-esteem of the group.

There are many extracts from this set of group stories that correlate with themes that arose in the stories created by my classes. Most stories gave an indication of how each particular student viewed mathematics, many mentioned change and transition and an inconsistency in mathematics and its expectations. Unlike my students, the higher set stories gave an overall message that mathematics was a means to an end in as much as getting a particular grade was the key to their future.

In summary, colleague A reported that all students happily took part in the storytelling workshop and the process seemed enjoyable. She also enjoyed facilitating the workshop and reinforced my feelings about the timing of the stories, pointing out that they could be a very powerful tool for teaching and learning if known early in a student’s mathematical career. She felt that allowing students this type of voice could help her plan effectively. She found that there was a difference in the stories told by able mathematical students and the less able, and that she personally found the stories told by less able students more informative, in the sense that she could use the story content to plan her teaching for those students more effectively.

8.6 Conclusion

In phase 2 the storytelling workshop was conducted with two groups that were similar ages and at the same stage of their GCSE course, yet there was a difference in how they tackled their stories in the storytelling workshop. One group, group A, produced four personal narratives, four poster type stories and one fairy tale. The other group, group B, all produced personal narratives. When I discussed this fact with a colleague I also started to note the subtle differences between the positions of the two groups as mathematic learners. Group A were a borderline group that were mostly targeted C grade at GCSE, they were all on course for this target, and had consistency in teachers for the last three years. Their stories gave an impression of being in control and on target, they indicated that they would work hard and fight to achieve their grade. Some students made posters and my assumption about this was that they had no burning desire to tell their story. Group B were also a borderline group and most were also targeted a C although two were targeted higher than this. They had a history of being a little difficult to manage with a small number of students displaying poor behaviour. Their record of teachers over the last three years was not so consistent. Many of these stories conveyed an air of helplessness and no real fight or ideas relating to how they might be successful in this subject. I found the differences in the stories between the two groups interesting and felt that through knowledge of their stories, it might be possible for a teacher to address social issues that were particular to specific groups of students.

In the next chapter, I examine the content of particular stories and describe the influence that they had on my thinking and practice.

Chapter 9 Phase 2 and 3: Selected Individual Stories

I entered into the phase 2 section of this research with some specific targets in mind. Firstly, I wanted to collect individual stories rather than group stories, and secondly, I wanted to hear the stories of students that may have found learning school mathematics a struggle. I had some assumptions in mind when designing this phase and I was keen to see the outcome of the data collection. I had begun to understand that the stories could be a very good way of getting to know certain mathematically related views and behaviours about individual students that could be very beneficial to my planning and work with that student. I was also keen to explore the changes in class engagement and behaviour after the storytelling workshop.

I used the phase 2 section of the research to a) examine the stories of a purposefully selected sample of students and b) consider how the content of the stories supports or rejects my initial themes. At the end of phase 2, I had read 17 stories written by year 11 students, each story made a contribution to the development of this research but a few stories surprised me and made me reflect on my reaction to the stories and my practice with that student. I started to think also about data that suggested that the students also gained some benefit from sharing their story.

The data produced by my student research participants was varied and rich in content and form. I found myself spending hours reading the stories and dwelling on what they might mean to me personally, and in my quest to improve my teaching practice. To focus myself on developing this phase of my research, I returned to my initial research questions, which were:

Is learning mathematics an uncomfortable memory for many people, and if so, why? and; How can I create a more approachable and effective interface between mathematics teachers and their students?

The uniqueness of the student stories and the impression that they made on me encouraged me to build into my data analysis model an opportunity to study each story as a whole unit, thus preserving the story message. I felt that this process complemented my narrative approach to the research and preserved that uniqueness that was unveiling itself as crucial information in this research. I also felt that by looking for patterns and set themes and applying a set of questions taken from a symbolic interactionist view point, I was learning and expanding my field of view, and trying to avoid overlooking significant areas of interest to this research. The themes compiled through the process of intuitive inquiry and thematic analysis provided a variety of information that could contribute to a discussion regarding how students felt when learning school mathematics. To address the second of my research questions above, I felt that I could make the following claims about what I had started to appreciate from working with my student stories: The first was that knowing more about historical and social interactions pertaining to the learning of mathematics for each student was enhancing my ability to teach them effectively and sympathetically. The second was that encouraging students to explore their voice through the creation of a mathematical story was influencing the relationship between student and teacher, and was contributing to the growth of student and teacher confidence with respect to the learning of mathematics. These claims were based on my understanding, which was drawn from studying the data that was produced across the three phases. I discovered that the student stories could give me information about my students that would often stay invisible to me during my

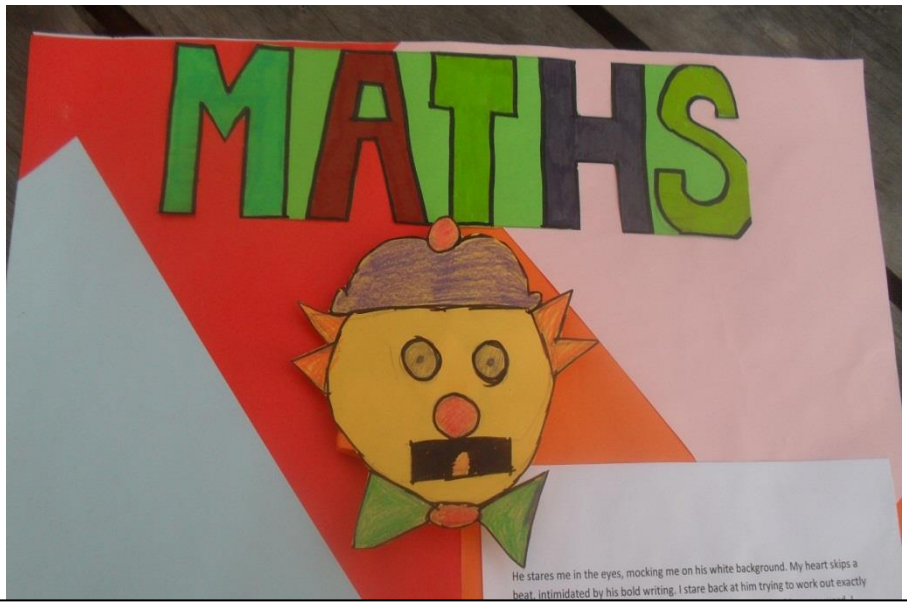
normal daily classroom interactions with those students. Some examples of this information included their feelings, fears, expectations and ambitions. This additional knowledge allowed me to consider reflexively my position and the position of the student when manoeuvring the mathematical classroom terrain. This classroom terrain is influenced by my expectations, biases, behaviours, and values, my choice of language (including body language) and my mathematical approach. In addition, the classroom terrain is a function of the expectations and behaviour of the students and the general ethos of the establishment. It is possible that these understandings and expectations are not shared by the teacher, the student and the establishment which can lead to non-harmonious classroom practices. Knowing the student stories can help me, the teacher, gauge the best approaches needed to challenge or support student thinking and student behaviour, consider the appropriate degree of sensitivity needed when correcting a student response, and plan what design of task (open, closed, short or extended) will best stimulate a particular student.

I felt that the process of students creating their story about their mathematical experiences could be thought of as students constructing new ways of being during the story. Through the medium of stories, students can relive experiences, justify behaviours, rewrite endings and try out scenarios, allowing a relatively safe way to experiment with new ideas and plot lines. An understanding of oneself across time can be accomplished by organising and clarifying temporal experiences through the medium of narrative, which Ricoeur (1986) described as a narrative identity. The data that follows includes some examples of the memorable mathematical stories that my students created and the influence these stories had on my practice. The stories have been selected from the phase 2 and 3 section of this research.

I have selected three individual stories from phase 2 and four from phase 3. The particular stories caught me by surprise and I found myself dwelling on their content and my classroom recollections of the student author. They were not the only stories that surprised me but were selected by me on the basis of the influence they had on me, their contrast to each other and the differing relationship I had with the students. For the purpose of exploring analysis I will limit my discussion to the three following areas: firstly, how the story addresses the themes developed earlier; secondly, how the story addresses my initial research questions; and thirdly, the surprises and influence on my teaching.

When I read the phase 2 stories, I had very little teaching time left with these students before they started their examinations. In hindsight, the timing of the story telling workshop was a limitation of the research design because the subsequent teacher/student interactions that happened after the stories were shared, has now become a very important aspect of this research.

9.1 Phase 2 Year 11 Clown



He stares me in the eyes, mocking me on his white background. My heart skips a beat, intimidated by his bold writing. I stare back at him trying to work out exactly what he wants from me. I read over him repeatedly analysing his every word. I slowly put my pen to paper and begin to write my only wish to please him and take the marks wrapped up in him and add them to my score.

As my ball point pen connects to the paper he begins to make sense his once mean and intimidating persona now becomes simple and easy to read. I take all I can from him leaving him powerless and completely worked out. With his power adding to my score, I then turn the page and go on to his brother.

When this story was being created the student shared with me the thinking behind the image. She had been working on the clown face for a little while and she explained that she found the face scary but if you looked at it longer it was actually ok. This she said, was like maths questions, when she first saw them she was scared but the longer she spent looking at them the better they became. She attached the clown head protruding from the paper on folded concertina paper (like a spring). This made the head stick out a little and wobble. At this time there was no writing with this image, the writing was attached at the end.

My first thoughts and reflections were as follows; I was impressed by the student's considered depth of analysis regarding her relationship with mathematics. We had spoken before the story creation about her fear of tests but we had not reached a solution about how to deal with things. I was aware that this student was a very logical thinker, and was very frustrated by her exam results which tended to be a grade under her school target grade. Target grades are compiled by the school and usually based on primary school performance and this student's target grade was a grade higher than any other person in the class. This target grade is not just from mathematics achievement but an amalgamation of the points scored in core subjects (English, mathematics and science) in primary school and at the end of year 9 (KS3).

When the student attached her writing to the clown image and asked me if I would like to read it, I was attracted by the descriptions, the use of metaphor and the way it played on my emotions. The image of the clown immediately caught my attention. The face is not particularly pleasant and the neck was made in the form of a spring so that it wobbles at you, making the whole image a bit unsettling. The student took her story into another room and made a short recording for me.

9.11 Phase 2 Year 11 Clown: Recorded Transcript.

> *Em, this is my maths, em, poster, and the clown here explains em what I think when I see a maths, em, exam so it's very scary. And then, but really inside when I start working it out, represented by the pink and the blue, it's not as scary as it looks.*

9.12 Clown Story: The Faces of Mathematics

Mathematics is portrayed as powerful, bold, and mocking. It is confrontational – it stares, 'bold writing on a white background'. It wants something from the author - it

takes, and the author wants to please it - ‘my only wish to please it’. The author takes the role of the subject in a power relationship and my thoughts flash back to the pilot stories where another author refers to pleasing the teacher, and another suggests that they are pleasing their parents.

Mathematics appears to be male, ‘**he’** appears mean and intimidating but there is a softer side ‘he becomes simple and easy to read’. The author takes from **him** and leaves him powerless. Power is threaded through the whole extract; if you can work out the maths you hold the power. There is a measure called score – power adding to my score. It seems that increasing the score gives you power. In this story gaining the power is important and so by association your score is important. The whole story feels ruthless and the sentence ‘leaving him powerless and completely worked out’ makes me think about the concept of knowledge. I wonder is the student suggesting that knowledge is powerful when it is not shared and if you can work it out then you also hold the knowledge, which by association, makes you powerful. The author feels strength at overcoming the mathematic problem; this is cumulative, building to gain strength for the next problem. There is a sense of victory, a feeling of power. I cannot help but worry about what happens if the mathematics is not overcome and rendered powerless? What happens to the next problem?

The story suggests to me that the student is able to function in an independent way. She shows determination and courage and a refusal to be defeated by a mathematics question. It is possible that endurance, perseverance and strength of mind are considered by the student as important for mathematics. However doing

mathematics questions makes her feel nervous, anxious or scared, indicated by the phrase ‘my heart skips a beat’.

9.13 Clown story: The Culture of School Mathematics

What appears to be recognised as ‘doing’ mathematics is answering the question then moving to the next question. The story suggests that by overcoming you please, but the question that forms in my head is who or what is pleased, the student, the teacher, parents or the school system? The story implies that this battle is a common way of working with mathematics. Mathematics elicits this battle by its provoking stance which makes me think that the author feels frustration when ‘doing’ mathematics problems and the struggle is never-ending, it just moves on. It occurs to me that this may be a reflection of the way the student views the mathematics lesson and it is something for me to give consideration to. There is no sharing, no equality, no compassion and no relief, as the victory is short and the girl has to do battle again. I have tried to imagine a setting where this sequence would look natural and I can only align it with a relationship that acknowledges that whatever you do, it is not good enough. Is this something this student lives with or has experienced in a mathematics classroom? Perhaps it is in her personality, or it is a message from somebody close.

Teachers do not feature explicitly, however the story conveys a discourse that is associated with mathematics teaching - ’Bold writing on white background’. The image of a next question makes me think of common instructions used in the mathematics classroom, ‘Do the next question’ and ‘complete the exercise’. There is

a sense that the working on the question is important, no mention of the right answer just ‘all worked out’.

The student gives the impression that she is alone in this battle and she must be able to overcome the problem and solve it. At no time does she mention help or support. The story implies a relationship with a male; it comes across as intimate yet one- sided with the author as subject. It conveys a situation of trying to please but as a ‘Trojan horse’ with a real intention to conquer and ‘leave wasted’. It feels like a battle in which there has to be a victor. The student gives me a strong message that she knows that she is able to complete the mathematics, she has the ability but there is always something that halts this process momentarily.

9.14 Clown Story: The Surprise

The surprise for me was that I had seriously underestimated the depth of feeling and emotion that this student was undergoing during tests and exams. Before I read the story, I was aware that this student had a problem with tests and exams. She had explained that she felt she did not perform well under this pressure and was usually frustrated with the results. My initial assumption was that her difficulty was with her preparation for tests and exams, and that she was experiencing what many students feel which is often referred to as exam nerves. The pressure of school assessments is often a talking point amongst teachers and students and it is a common assumption that students will get ‘over it’ with practise and time. My normal response to this sort of problem would be to advise and support the way the student prepares for the exam or test. However, if my assumption was correct it would happen in all

subject tests and exams but this student shared during interview that this phenomenon was restricted to mathematics.

9.15 Clown Story Interview

The interview with this student started off with questions about the clown face and general questions about her story and the struggle she has with examination questions. The response to these questions helped shape my interpretation of the story and subsequent planning for this student and informs the discussion in the next section. In addition I asked the two final questions below. The researcher questions are in italic.

> *Did you find it useful to write your mathematics story?*
>
> I think it is, it kind of made me realise that it is not so much my ability it is the confidence side of stuff, I think.
>
> *Do you think it would be useful to maths teachers to read a student's story while they are teaching them?*
>
> Yeh, I think it would help them understand what their point of view towards maths is and then, to cater to those needs

9.16 Clown Story Discussion

This story influences the way I think about this girl and subsequently the way I deal with her in my day to day teaching. How I might present a mathematics test to a class that contains this student needs serious consideration. It certainly could not be on white paper with bold writing, and contain lots of questions. The language I might use in conversation about mathematics questions would now be informed by what I know. It would not now seem appropriate to suggest that she should try harder in a test, or that she might need to improve her performance. I would want to move away from the aspects of conquer, win, defeat by moving the emphasis away from

questions and classroom procedures that had one correct answer, and I would focus more on exploring lessons where marks were awarded for working and ideas but not for answers. To move away from a focus of just answering questions, I would build into each lesson some time spent reading a mathematical question but instead of trying to answer it, establish a thinking time for collecting thoughts, some notes and/or diagrams about the question and then some class feedback. This could lead to this student writing her own exam questions for others ensuring that problems with mathematical language and communication were highlighted.

I feel this student does not hold a strong mathematical identity. She is not comfortable doing mathematics or conforming to the day to day procedural side. She is not empowered by her mathematical skills, although others with similar abilities might be. She knows that passing in mathematics will strengthen her social empowerment and this awareness could be intensifying the problem. She does not indicate in her story that she finds the questions difficult or that she cannot answer them. There is only a sense that they frighten her, her personal empowerment is penetrated, and she loses confidence in herself.

My relationship with the student was comfortable, we shared a common interest in riding horses and she had riding lessons at a local stable that I also rode at. After her story I spoke to her often about her aspirations for the next few years and where mathematics featured in this plan. For her, mathematics was a means to an end, she needed a C grade to get into college but that was her only interest in the subject. I was uncomfortable with her view of mathematics and I wanted to explore with her

the other faces that mathematics could present, perhaps one that could show a more enjoyable aspect of mathematics. I also wanted to explore with her the place of challenge and cognitive wrestling in mathematics and how working like this did not necessarily constitute a struggle or a fight.

She was a very accomplished dance student, a very good English student and was also expecting good grades in all other subjects. I knew she was a very good mathematician because her verbal responses to mathematical situations were reasoned, logical and accurate, but she was hesitant with her written work, wanting to be sure she was correct before committing her writing to the black and white page.

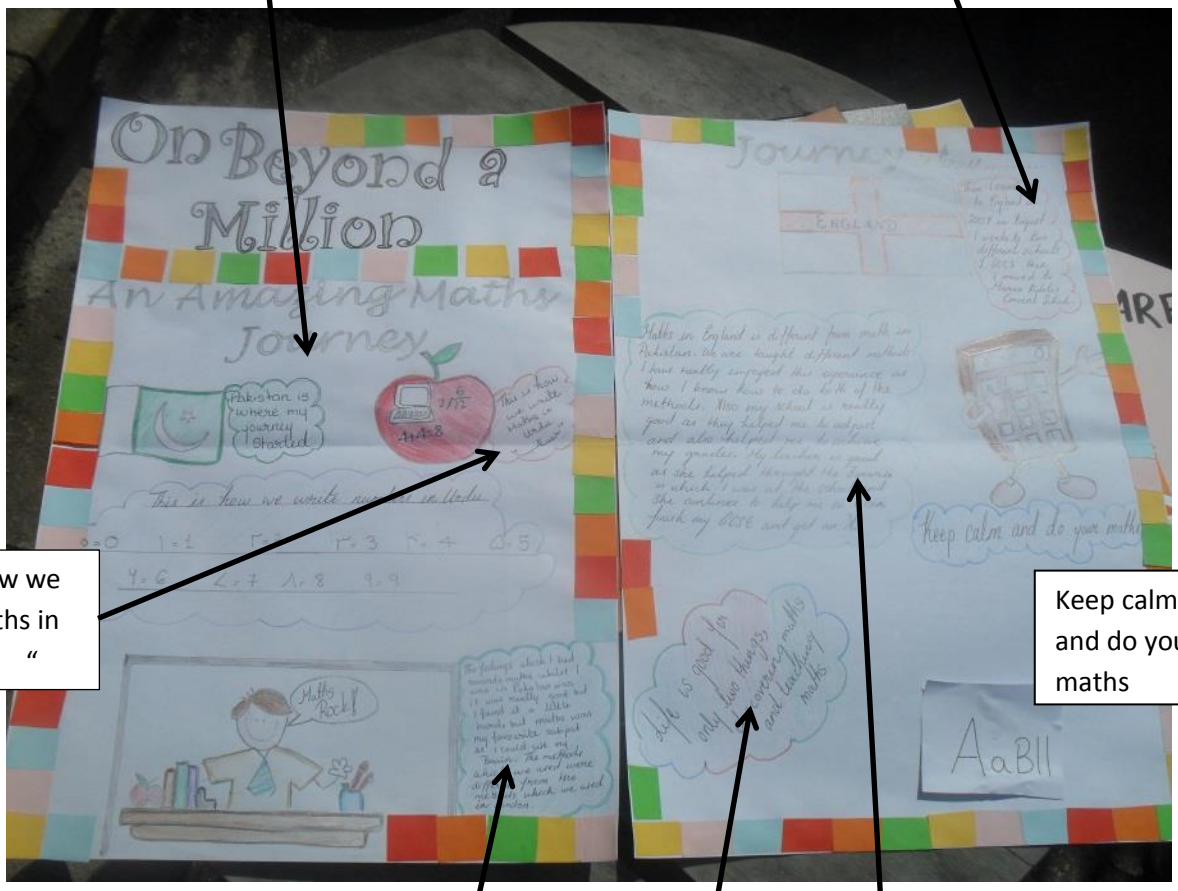
Over the short period of time left with this year 11 class, I put together a programme of activities that would support some of the issues that I had encountered in the student stories. Some activities were built into the lessons and others used a few minutes at packing away time. I devised a set of class work activities that encouraged putting ideas on paper, including using writing frames, brainstorming, and spider diagrams, all before actually formulating a solution to a problem. We discussed how mathematics might feature in other more favoured activities such as dance and art. We also talked about subject phobias and fears, and what strategies people have for dealing with disappointing results. This student's skills and confidence when faced with a written mathematical problem developed over this period of time. In class she displayed a good understanding of numerical techniques, logical thinking, good powers of analysis and she was very quick thinking. She knew how to work outside of the lesson and access mathematical information to support her learning. She knew that she was good at mathematics and I watched her

mathematical and personal empowerment growing over time and she did achieve the grade she needed when she finally sat her GCSE exam.

9.2 Phase 2 Year 11: On Beyond a Million

Pakistan is where my journey started.

When I came to England in 2007 in August I went to two different schools. 1 {school name } then I moved to {current school name}.



This is how we write maths in Urdu “ “

Keep calm and do your maths

The feelings that I had towards maths whilst I was in Pakistan was it was really good but I found it a little hard, but maths was my favourite subject as I could use my brain. The methods which we used were different from the methods which we used in London.

Life is good for two things, discovering maths and teaching maths.

Maths in England is different from maths in Pakistan. We are taught different methods. I have really enjoyed this experience as now I know how to do both of the methods. Also my school is really good as they helped me to adjust and also helped me to achieve my grades. My teacher is great as she helped throughout the three years I was at school and she continues to help me so that I can finish my GCSE’s and get an A.

At the time of the story creation I made some brief notes as follows: this student worked on her own to create this story, she took it home with her to spend more time and appeared to view her story as very important, giving full attention to what she was doing. When finished she took her work to the next door classroom and made a short recording to explain her work.

My first thoughts and reflections were that this story attracted me because it was a celebration of learning mathematics and I admired how the student embraced the opportunity to learn. Again, although I felt I knew this student well, I discovered through the story that I had no real understanding of what made her function as she did in the mathematics classroom. After reading the story, I began to appreciate some of her behaviours and felt a responsibility to contribute to the positive story plot.

This is a story that has a sequence through it. It is a very positive story and I felt that the student was proud to communicate it to me. I felt that it was personal by the fact that she worked on her own and did not attempt to share with other students. This does, however reflect how this student liked to work in mathematics lessons which was on her own unless directed by the teacher to work with or support other students.

9.21 On Beyond a Million: Interview with the Student

(The researcher questions are in italic)

Why did you call your story 'On Beyond a Million'?

Because I like maths so much, I really enjoy it.

What is the significance of using the word million?

It is because it is better than the rest.

Your story suggests that you are very positive about mathematics and learning maths. Is that what you tried to show?

Yes

Was there a time in your life where you felt less positive about learning mathematics?

Probably when I wasn't interested at the time

When was this?

(Student shrugs),I was a bit chilled out.

When did that change?

When I came here cos I saw the difference in the life styles and everything, and I saw that I could pay more attention to everything.

Leading on from that then when you came to England what was your first impression of mathematics in this country?

It was a bit awkward in my old school because they did not teach much cos they were an art school and they concentrated more on art not on other subjects that much.

Is that the impression you got from that because they were called an art school?

It was just like they didn't concentrate much cos like I didn't get the levels, what they were teaching you was not good, you can tell by the levels that what they were teaching you wasn't good enough for me to learn.

Was that in the maths lessons?

Yes

In your story you call it an 'amazing maths journey'. Why is this?

Because as the years developed my interest developed and I learnt more, probably this is one of the subjects I never get bored in but some of the subjects are boring and I feel like falling asleep, but maths is every time something new and I never get bored in it.

If you had to sum up the main differences between mathematics in Pakistan and mathematics in England, what would they be?

Here it is more functional and there it is a bit more formal. In Pakistan I found the mathematics difficult but I did not care, I did not really care about any of the subjects. I just did them and it did not matter if I did not understand it. When I got to England I started at [school name] and I got terrible grades in year 7 and I still did not really understand much but I kept my head down and just did what I was told. When my sister came to this school and started to do well my parents realised that they should change me to here. Here people care and when I heard the students talking about how much they struggle to understand I started to care and realised it was important. I really started to like maths when you taught me

because I could understand the way you were explaining things and then I started to enjoy maths.

You use the phrase; 'Keep calm and do your Maths'. Why did you include this phrase?

Because it is important to keep calm

Does this mean that sometimes you are not calm?

Yes, in maths and English I look at the question and I don't feel calm but I know to stay calm and look again at it and I will be able to answer it.

Do you think it is useful for a teacher to know a student's mathematical story?

Yes

Why?

Because that way they get to know a bit more about the way a student feels and then they can…I think they can teach their students better if they know more about them.

Is it useful for you to write your mathematical story?

Yes it is good to be able to tell your story in this way; sometimes it is difficult to just say it. When I want to say something and I feel it is a bit difficult to say I write letters- I often write letters to my mum.

9.22 On Beyond a Million: The Faces of Mathematics

This student presents mathematics as being fun and the chance to use her brain. She acknowledges that it can be hard but enjoys the challenge. In this story she talks about two views of mathematics: a formal face of mathematics and a functional face. She indicates that although she always enjoyed the challenge of mathematics, with the formal face she just did the work and it did not matter to her whether she understood it. The functional face however involved teacher explanation and her understanding the method as opposed to just applying it. She speaks about different methods used in Pakistan and in England, however it is likely that the methods are similar, but one focuses on applying an algorithm and the other focuses on problem solving to adapt or create a specific algorithm. This student's love of mathematics has helped her to embrace both approaches to learning mathematics, helping her to

realise that an important aspect of mathematics is thinking and understanding. I now know from my work with her that she loves mathematics unconditionally, she will stick with the mathematics until she really understands it, it does not matter how many times or how long it takes.

9.23 On Beyond a Million: The Culture of School Mathematics

This student wants a grade A in GCSE mathematics even though her school prediction is a grade C. My observations are that there is an element of pride involved in this ambition and it is important to her to do better than her peers. She works alone if possible and I have assumed that she uses the mathematics lesson as a way of marking her status in the group, she sends out signals that mathematics is important and her time cannot be wasted.

This student expects the teacher to be in control and teach her mathematics; she expects the teacher to deliver something that advances her learning. Her interview suggests that if she is not achieving good grades then the teaching is not good enough. She recognises that there are different methods used in teaching mathematics and states that these are different in Pakistan and England. I know from working with her that she likes to learn a method and then enjoys applying it. This focus on method possibly stems from the formal face of mathematics presented to her in her first years of learning mathematics, and when I first started teaching her she relied far too readily on having a method. Later on she mentions that she likes mathematics because it makes you use your brain and also that she likes things explained so that she understands. This signifies to me a move away from a method

type approach of a formal mathematics face and a step towards what this student refers to as a ‘functional’ face.

This student states in her story that you should ‘keep calm and do your maths’, and during the interview she explained that she felt it was important for her to stay calm when reading mathematics and English questions, this allowed her some thinking time and then she could tackle the question. This was an interesting correlation with the story called ‘Clown’ who also talked about her first reading of a mathematics question and how it made her feel.

Relationship with school and teachers is a theme in this story. She indicates that in her early education years she viewed school and maths as unimportant and did not engage with the process. But at some point, from listening to her peers, she began to view learning as important and started to embrace the process. At this point a relationship developed between the student and the learning, and the student and teachers.

9.24 On Beyond a Million: The Surprise

My surprise was a two-fold one, the first was how intense the positive story was. I knew that this student had struggled over and over again with the more difficult mathematics topics yet there was no mention of this in the story. The second was my initial lack of empathy with this student and lack of understanding about what makes her function, until I read the story I had been confident that I understood her well.

9.25 My Diary Extract

I have worked with this student for three years but only two in the capacity of her mathematics teacher. When she arrived at the school she was placed in my form, so I became her form tutor. She had come to England two years before that and attended a school that was nearby, but once her younger sister arrived in England and was placed in this school, her parents decided that she should also attend this school. In the first year she struggled with fitting in and seemed quite isolated. Her sister was achieving extremely high grades in all her assessments but this student was not, her grades were very low in comparison with her peers.

She often came to my classroom to chat, usually with a friend, and they would chirp away happily asking me fairly immature questions about the school or teachers, or my opinion about an event etc. She was always smiling and happy, being silly and joking. However, when required we did talk about her progress and achievements and it was clear to me at that time that this was a very hardworking student who was struggling in all her subjects including mathematics. I was her tutor for a year and the next year she had a different tutor, yet she often arrived at my classroom during lunch or break and asked if she could stay there and get some work done. I would always oblige and let her stay. In the third year of knowing this student I became her mathematics teacher. The class was assigned to me because the students were what the school labelled as an intervention group, a group of students that should be able to achieve a C grade or better on their GCSE mathematics exam but to date were not meeting their expected targets. This student fell into that category and so became one of my mathematics students. Reading her story answered so many of my silent questions, I knew she had come from another school but did not understand that she had started her education in another country. I thought that she had a very strong work ethos but did not understand that she was driven by her love of mathematics. I now knew that although she liked to rely on a method to support her mathematics work, she wanted to understand more about why the method worked. I began to appreciate the place of her ambition; that for her, personal growth and cognitive process was important because she thoroughly enjoyed the challenge. I had initially viewed this student as attention seeking and when I was particularly busy I had felt a little irritated that she was always hanging around the classroom. After reading the story, these memories flooded my senses and stirred uncomfortable feelings. Instead of feeling irritated that this student had taken a lot of my spare time chatting and playing, I now felt admiration for the student and she now could have as much time as she wanted.

9.26 On Beyond a Million: Conclusion

I feel that this student exemplifies the role of empowerment. I had watched her mathematical empowerment grow over the last year. Developing alongside this was her personal empowerment; she grew in confidence and enthusiasm and eventually started to take risks with her mathematics. I had always thought that social empowerment was her goal in learning mathematics but the story has persuaded me that she really enjoys it and embraces the challenge; this is something that I wish I had appreciated at the start of our time working together.

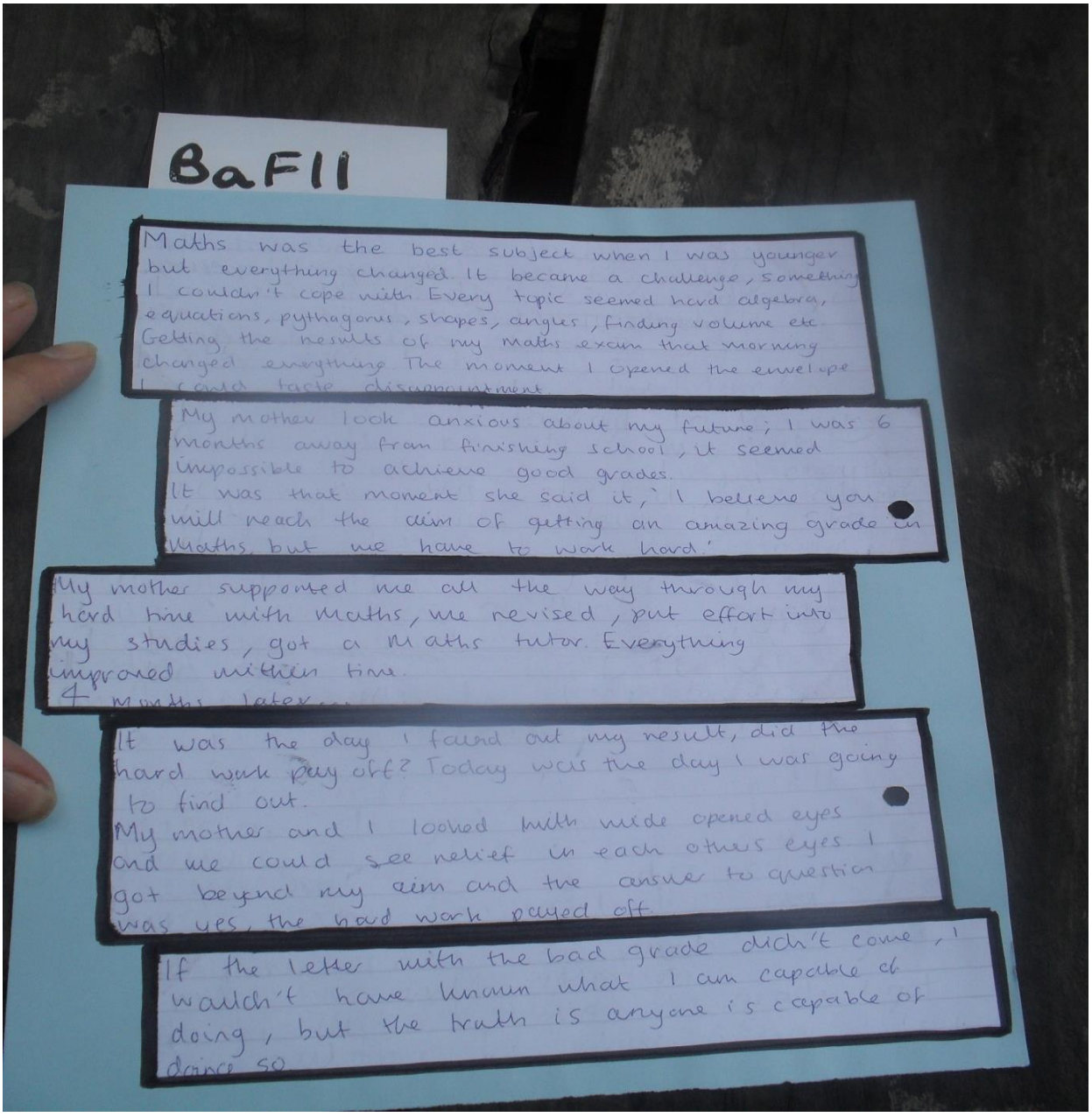
This student story has implications for me, the teacher. If I had more time left teaching this group, I would like to set this student a variety of activities that embrace the beauty of mathematics, incorporating aspects of mathematics that are interesting but not on the GCSE curriculum. I understand now that she would really love to explore the subject further. I also think that this student would happily work with me outside of the lesson at clubs and events, and her mathematical exploration could be stretched beyond any school set targets. As an improvement to the social aspect of learning mathematics, I would encourage this student to work more collaboratively in the classroom, sharing this enthusiasm and positivity; this would benefit her communication skills in mathematics and enhance the classroom environment. I would also like to explore the original mathematical methods that she was taught in Pakistan, we could look at the similarities and differences between those methods and ones taught in English schools. This would help her unpick and now understand those more formal ways of working. Lastly, but probably most important, I would like to wean her away from the need of having a teacher deliver

mathematics to her, setting her tasks to explore and feedback areas of mathematics that particularly interested her.

In the short time left with this student I was able to focus on some of these aspects of learning mathematics. Some of the things suggested above were already used in my teaching but now I could assign this student, and other students that had shared their story, particular activities that addressed their individual interests and needs.

In terms of my initial research questions, this student does not view learning mathematics as an uncomfortable experience. She may have had some uncomfortable moments on her ‘amazing journey’ but for her, they are all part of the whole package. I expect that as an adult she will tell an equally positive story about learning mathematics. Her GCSE grade was not that iconic grade of A that she stated she wanted, but she told me that she was very happy with her grade B and would like to continue to study more mathematics. She returned to Pakistan for the next stage of her education and mathematics was an integral part of the science course that she enrolled on. This young lady contacts me every now and then, and at the time of writing this thesis she was studying in Pakistan.

9.3 Phase 2 Year 11: The Letter with the Bad Grade.



(Story text)

Maths was the best subject when I was younger but everything changed. It became a challenge, something I couldn't cope with. Every topic seemed hard algebra, equations, Pythagoras, shapes, angles, finding volumes etc. Getting the results of my maths exam that morning changed everything. The minute I opened the envelope I could taste disappointment.

My mother looked anxious about my future; I was 6 months away from finishing school, it seemed impossible to achieve good grades.

It was that moment she said it, 'I believe you will reach the aim of an amazing grade in maths but we have to work hard.'

My mother supported me all the way through my hard time with maths, we revised, put effort into my studies, and got a maths tutor. Everything improved with time.

4 months later

It was the day I found out my results, did the hard work pay off? Today was the day I was going to find out. My mother and I looked with wide opened eyes and we could see relief in each other's eyes. I got beyond my aim and the answer to the question was yes, the hard work had paid off.

If the letter with the bad grade didn't come, I wouldn't have known what I am capable of doing, but the truth is anyone is capable of doing so.

9.31 The Letter with the Bad Grade: Introduction

I wanted to include this story as an example of the student story data because out of all the stories that were written this one caused me the most soul searching. After the story was written and I had read it, I thought long and hard about my role as a teacher and my relationship with this student.

9.32 My Diary Extract

(Student name) never really speaks to me – she mutters a short response to my questions but that is all she lets me have. I know that she can do the tasks I set to a certain degree but she works very slowly, and I also know that if I could help her she would make more progress, but when I approach her she curls into a little ball and I feel like an intruder. So I was surprised when she started to write her story. She curled into her ball and wrote for the three lessons. At the end of the workshop most students handed their stories in but (student name) wanted to keep hers. She said I could read it and take a copy.

I checked again with this student whether she was still happy for me to use her story with my research and she said that was fine but she would like to keep the original. I also asked her if she would consider taking part in an interview and she declined the invitation.

This student was in a different year 11 class than the authors of the last two stories. I have coded this group as BaF11 (B). I had been teaching this class for seven months when the storytelling workshop took place. Historically, this class had been highlighted as a difficult class due to the behaviour of a handful of students and when I started with them I found that there were some very dominant members of the group that liked to speak out and voice their opinion. In contrast, there were also some very quiet, gently behaved students that said very little and tended to be overshadowed by the others. Over the months, the more dominant students developed a better work ethos and used their energies in a more productive way. This allowed me to move around the class, spreading my time as equally as possible so that all the students had a chance to progress. Throughout the seven months most students were making good progress towards their GCSE grades, but they had entered the year with very poor results from the previous year, they seemed very frustrated and had a fairly poor idea of the work that they would need to put in to achieve their school targets.

The author of the story was making progress in her mathematics lessons but she did not speak to me of her own accord. This meant that if she was unable to proceed with the work I had set, she would wait for me to circulate and get to her for any

intervention. Sometimes she would be fine when I was with her and then get stuck after I had moved to someone else, but by keeping her head down she looked as if she was working. I was very aware of this situation and popped back to her as often as I could, but on many occasions there were other students indicating that they needed help and sometimes she would get left for a while. I always encourage students to ask each other for help if I seem busy, this then helps keep the work flowing, but this student sat alone and did not appear to mix with anyone else in the class. Often I directed another student to work with her but it was not something that she did for herself.

9.33 The Letter with the Bad Grade: The Faces of Mathematics.

This student's story starts by indicating that mathematics has changed for her. This is a common theme throughout the student stories and is often linked with age 'Maths was the best subject when I was younger but everything changed' (extract from student story). Her view of mathematics now, is that it is hard and a challenge. It is interesting that in the last story the fact that mathematics was a challenge is what made that student love it. Disappointing exam results are a main story line and again that is common in several student stories. Mathematics presents several faces in this story, a changeable one, a difficult and challenging one and a face that is linked with status. In addition she mentions her future and how her result in mathematics influences this, so mathematics also has its useful face showing.

9.34 The Letter with the Bad Grade: The Mathematics Classroom Culture

There is very little said in this story about mathematics classroom culture, it is almost as though it does not exist. This student relies on her support from home and her

mother takes control to make things right. I could speculate why a classroom culture does not seem to feature for this student but whatever the reason is, I will always feel that I should have been able to do more for this person.

9.35 The Letter with the Bad Grade: The Surprise

The surprise for me was how wrong I had got things and how little the student relied on me. I felt that I had not done enough for this student. I had experienced a dilemma in the way I needed to behave with this student and had made the decision that I needed to give her a little space. This was in response to what I thought her body language was suggesting. In fact, after reading her story, I now think that what she needed was more attention, more support, and more recognition that I understood her battle to succeed.

Knowing this story a little earlier would have helped me understand what was going on with this student. I suspect that the student was waiting until she saw her tutor to get help with her work and knowing this would have been a way to start a line of communication. In the time we had left, I arranged my planning to include work set to be done with mum and the tutor, this helped me communicate with the student in a way that was useful to what was actually happening in her world. This approach was particularly beneficial to me because I could then get a clear understanding of what work the student was completing with support at home and what work this student was confident to do on her own.

9.36 The Letter with the Bad Grade: Conclusion

Once I knew a little more about this student it felt much easier to communicate with her. I spoke to her privately about the work she did outside school and explained how I could support that and keep a check on her learning in class. When we ran out of time in a lesson, I now knew that I could write a short note in her planner so that the work could be continued at home. She achieved a grade C in her GCSE which was her school target grade and was two grades higher than the grade achieved at the end of the previous year.

9.4 Phase 3 Stories: Introduction

Towards the end of my phase 2 data analysis I had become very excited about the data that supported my second research question which was: How can I create a more approachable and effective interface between mathematics teachers and their students? Keeping the stories as a whole unit gave me a chance to access a small window into the social life of my students learning mathematics. I could appreciate what was troubling them, and I could select appropriate informed responses to their behaviours and needs. This in turn allowed a more harmonious relationship to develop between mathematics teacher (me) and story author (the student). In phase 3, I decided to build on the work already started and keep the stories as a whole unit. With this format, I considered the two themes developed in the previous phases and the influence that the story had on teacher practice.

Two particular aspects of the phase 1 and 2 data analysis had made a strong impression on me and started to influence my work in the classroom. The first was

that although I entered this research feeling I understood the students that I was teaching, it was now evident to me that my understanding was limited and not always accurate, in fact, sometimes it was wrong. The stories opened up a new way of thinking about some students, they seemed to open doorways that I did not know existed and these doorways influenced my thought processes. They encouraged me to make tailored plans that could factor in the needs of these students. I had discovered that attending to these needs did not detract from the quality of the mathematics that was taking place in the classroom. For some students their mathematical engagement improved, they appeared more relaxed when faced with mathematics and they grew in confidence as mathematicians and as achieving students. The one drawback for me from the phase 1 and 2 research design was the timing of the storytelling workshops. In both phases the storytelling workshop and subsequent analysis took place in the latter part of the academic year which left me very little time to analyse the stories and monitor my subsequent classroom practice. In phase 2, I had roughly two months teaching time left with the students and in addition, it was an unusual time of the year as they were in the last two months of preparing for GCSE's. I felt that the next phase of this research should focus on my enlightened understanding of the students once they have taken part in the storytelling workshop, and how this understanding informs and manipulates my practice with those students. The design of the phase 3 was organised to take into account any difficulties encountered in my previous work and a) facilitate the storytelling workshop with students who were not preparing for an imminent exam, and b) have the workshop earlier in the academic year to allow me a longer observation period afterwards. I chose a sample of students that consisted of a group of year 9 students (age 12 and 13) and a group of year 10 students (age

14and 15). Both groups had been highlighted by the school as making very little mathematical progress from entering the school at age 11 until now. The number of students in each group was kept small so that they could receive as much teacher help as possible during mathematics lessons. The year 9 group consisted of 12 students and the year 10 consisted of 15 students. From these groups I have selected four stories, chosen to highlight to you a) the very different contexts and content that are portrayed in the stories; b) the impact they had on me when I read them, which I will call the surprise; and c) the subsequent development of the student after the storytelling workshop. All stories were treated with the same importance and my subsequent interactions with each student were influenced by the stories. However, as before there were differences in the way some students embraced the storytelling process, with a variety in the type and length of story. I now began to consider that one possible way for a student to discreetly not take part in the storytelling workshop yet still appear to comply with the process is by making factual posters containing formulas and rules. Over the three phases, a very small number of students made mathematical formula posters which contained no information about their story, I now feel that this was their way of withdrawing from the process. I have selected the following stories on the basis that they each demonstrate in a different way how valuable the storytelling process can be to a teacher. In the first two, the authors are students that I found initially very difficult to work with, but once the stories had been shared I found this new knowledge and understanding helped me develop effective strategies to foster the student/teacher relationship. The third story was chosen because it gives an example of how a story can be written in a style that suits the author. I have included the fourth story, Amy, because it contains a lot of information about classroom culture.

9.5 Phase 3 Year 10: Bullies

Primary was never really the best time of my life
With Bullies, work and my weight on my mind.
I was striving to do the best I can
But never was I the best of the class.
I was the dumbest of them all
Oh, I couldn't tell the time.

The time ticks by faster and faster.
Next thing I know secondary arrived.
I was always the odd one out.
No one understood my character and act.

Maths at my first school never had an effect,
Messing around and throwing things about.
We left the room and turned around,
The room was always left in a state
And all the children will look at the teacher in spite because he could not cope.

The kids thought the maths room was a playroom.
Work was never done and so our grades never improved.
A flood load of detentions and a load of teachers on my back.
I was very sure the life of mathematics was never for me.

With algebra and square root of what?
My head puzzled with the alphabet in the maths.
Stem and leaf, oh when did it become science.
What happened to 1 +1 and 2+ 2?

At the time of reading this story I wrote these first impressions.

My Diary Extract

This student paints a bleak story of schooling, and I get the impression that she is not happy in a situation where the adult is not in control. It makes her feel spite. She makes no mention of her more recent

experiences and perhaps the earlier ones have made such a stamp on her expectations that there is nothing else.

I would like to build the next chapter with her. My initial thoughts are that it should include authority as a safe haven, a lack of ranking in mathematics as a classroom concept yet always include a celebration of what she can actually do. Importance should be placed on being mathematical so that she acknowledges what that is and recognises it in herself. I feel that issues of kindness and acceptance are paramount and I need to be particularly careful about being explicit when these things are displayed so that she recognises these two attributes in herself and the way she is treated. I would like (student name) to be able to write her next chapter with the help of my informed classroom practice in mathematics.

In phase 3, I decided to address the following question, 'How does reading a student story affect the way I think about them and hence my subsequent interactions with them?' Well, without this story I would probably take this student on face value. My initial feelings about this student were that she could sometimes be a bully. She had given me this impression by hanging around after the lesson telling stories to anyone who was around to listen, describing fights that she has been part of. Most of these seemed to happen outside of school and so I had no way to verify the truth of the stories. I had found it difficult to warm to her and had often found her very irritating, which meant that I had to work very hard to ensure that this was not noticed by this student and the rest of the class. She would often giggle loudly for no apparent reason and tried hard to start redundant conversation with nearby students, always in the middle of her mathematics work, thus distracting other students from their work. She was in the habit of calling out randomly when I was addressing the whole class, and sometimes these contributions were hard to justify as relevant to the topic of discussion. This set of behaviours made me annoyed as I am committed to fairness and respect in a working classroom and I view distracting others from the lesson and violent behaviour, both as acts that oppose these values.

However, on the other hand, she could work very well in the class, completing some good work and usually ranking higher than others in class assessments. She was usually responsive when I asked her a question and was happy for me to sit with her to look at her work or explain something. When she had completed an assessment well, she sometimes appeared unsure of its value and was very happy when I explained that I felt that her result was good. However, she then could be a little unkind to others who had not matched her performance. Again, I find this difficult as public announcement of test results is not a classroom practice that I encourage.

The story gave me more information to help me focus my understanding of this student. I actually had thought her work ethos and mathematical identity were fairly positive. I did not appreciate her sensitivity or her need for somebody to be in control. I now understand that her self-esteem was low and needed to be protected, and with that in mind I felt the need to choose my choice of words carefully when I chastised this student.

9.51 My Diary Extract after the Story Workshop

> *I am really starting to like these kids and I feel a need to go back to their stories and consider how they influence how I deal with them.*
>
> *I am aware that (student name) has low self-esteem about her weight and her mathematical ability. She has experienced bullying and is completely influenced by her peers. She has decided that mathematics is not for her. She says it is baffling, it has titles like 'stem and leaf' that are science but actually are not, and she misses the basic numeracy work of primary school.*
>
> *In lessons she tends to be serious about her work but seems to find it difficult to concentrate for the whole lesson. She turns around and has conversations with the students sitting behind her. I constantly have to remind her to work and I think I am only getting 50% of her effort. She seems to get on fairly well with the group although she makes a great effort to keep involved with them. This indicates to me that she is trying very hard to fit in. When I ask her to focus, or perhaps turn around she tends to look upset but I have noticed recently that her body language has*

relaxed a little and she smiles mischievously, I suspect this is because she now knows what is expected.

How do I treat her differently now that I have read her story?

There are many things I do as I get to know her that I may not have done without the story. What the stories do is accelerate that 'getting to know you' process. So where before, it has taken me a year to gain some understanding of the different way a student will function mathematically and socially, I now feel this amount of empathy has been achieved in a much shorter time. So for this student, I am strict on her behaviour with respect to how she treats others including me. However, disrespecting people needs understanding – by this I mean that you must know you are doing it to really be guilty of it. If I feel that (Student name) is out of line I will explain why I feel that and try to give her a scenario that she can identify with. I am acutely aware from her story that she needs to feel that the teacher is keeping law and order in the classroom. I think before the story, I would have applied the school rules more diligently and just viewed (student name) as a difficult student with poor manners.

With this student I also publically recognise good work and keep poor, incorrect work for a more private conversation. This is my attempt at helping her keep her self-esteem.

A later diary extract

(Student name) has had a bad lesson and showed me how difficult and rude she could be. As her story has informed me that she views a lack of discipline as a real weakness in the quality and ability of the teacher, I treated her behaviour straight down the line, text book school rules and she was disciplined accordingly. It felt hard making no small allowance for her having a 'bad day'; she has been such a good student on many occasions. Anyway, it seems to have worked, the next lesson she came back with her normal 'work orientated' attitude and actually completed some excellent work on expanding algebraic brackets. She offered to demonstrate on the board for others, and when she made an error, which was pointed out by other students in the class, she was quite chilled about the fact that there was something in her working that was incorrect. This seems like real progress, she is thinking mathematically, happy to participate in the lesson and demonstrate a model answer, and has enough self-esteem to make a mistake publically and then move on and correct it, all with a smile.

9.6 Phase 3 Year 9: Teachers are Rude

9.61 My Diary Extract

> *I ask myself why I chose to use this story as an example of data. Well, it is the story that has bothered me the most, the story that I have thought about the most and the story I have discussed with my colleagues the most. So for these reasons I know it must be a very important part of my data collection*

9.62 Phase 3 Year 9: Teachers are Rude. First Story

This group were a targeted group of year 9 students who were performing in mathematic assessments at a level lower than one that would be ideal for the end of year 8. They were selected from a variety of different classes, and were selected because they are achieving now, the same level in mathematics assessments, as they did in their final primary school assessments. They are essentially what many schools might call a bottom set class, and although they had some difficulties with concentration span and self-study, I did not feel that they presented extreme behaviour problems. The task was presented to them, the reason for the task was communicated and they happily set about creating their stories. The only objection to the process was this student, who did not want me to keep her story, so I put it in an envelope and gave it back to her. By the second lesson, she had changed her mind and asked me if I would like to keep her story. The text below is what the student gave me as her story:

> *Maths is boring and sometimes I feel like snoring.*
> *Teachers are rude and for some reason they give you attitude.*

In my past maths was good. I enjoyed it, I still do I just hate the fact that it is boring and usually many sums are complicated. Year 8 was the worst, my maths teacher was rude and I don't know why but it seems they pick on the quiet ones.

But on the other hand maths is quite essential to life because it involves a lot of things which is quite important.

I usually enjoy maths, but through my previous experience especially in year 8, my confidence in maths wasn't so good. In primary I preferred it more than I do now. PS maths isn't really boring.

9.63 My Diary Extract

My first impression of this student was that she was surly and uncooperative. She got on with her work quietly but worked on her own, deliberately keeping away from the other students in the class. When I asked her a question she had a habit of curling up her nose and frowning. Her body language sent signals for me to leave her alone and she kept her work very private.

Of course, much to her discomfort that is not my way of working, every lesson I like to look at the work of each student checking on individual progress so that I have a mental image of where a student is by the end of each lesson. This can sometimes be achieved by asking the student a question, but given this student's hostile body language, I did not want to highlight to the rest of the class any problems and so, I always sat beside her for a few minutes to look at her work.

Generally she turned away a little and made it clear she was not happy with me in such close proximity, and often I found it difficult to talk about the work as it was a one way conversation. At the end of the lesson, when the class had left, this student often waited behind and asked me to explain something that she had not understood in class. This was particularly frustrating because there had been ample opportunity in the lesson and I was normally limited by timetable constraints and on my way to another class.

I find this student very interesting. On the surface she seems to be polite and hard-working but digging a little deeper she shows me something different. Her initial story surprised me. I had seen what the student shows on the surface, the little bits of body language such as turned up nose and angry appearance, but I had assumed that she was babyish, lacking in social skills and had not yet developed her people skills.

I realise now that I should have thought about this a bit more because when I mentioned the facial expressions and body language and pointed out that it was a type of bad behaviour, she was surprised, claiming that she was a good girl and never got into trouble. She was really cross about what I had said and kept repeatedly asking 'do you really think that I am badly behaved?' Her first story filled in the spaces for me a little.

This is my thinking about this story and how, by knowing this story, I changed my perception of this student. This student had compiled her story of learning mathematics and her subsequent knowledge of this event around the rhythm of her previous mathematics classroom. In this classroom she interpreted the teacher intervention as rude, she assessed that her own behaviour in comparison with others was ‘quiet’ and had come to the conclusion that teachers ‘pick’ on quiet ones. Her story carried insults for a mathematics teacher ‘maths is boring’, ‘I feel like snoring’ and for all teachers, ‘teachers are rude, they give you attitude’. So is this just a really unpleasant student who thinks she is better than everybody else, or is there more going on?

She was angry and felt that she had been treated unfairly in her previous mathematics lessons. She was not, as I had first assumed, a student that lacked social skills, but one who had studied the behaviour of her fellow students and her mathematics teacher. I suspect that she was so used to seeing explicit bad behaviour from some students that she has never felt the need to think about her own behaviour. Her story really opened my eyes because I had made certain assumptions about this student, I had found her rude and assumed she was in control of her body language. Without the story, I am not confident that we could have forged the good working relationship that developed after the story. This was an angry girl who I think had been misunderstood by her teacher, particularly in the previous year. She did not understand that the teachers had actually misunderstood her and she had perceived their response as rude. Over the next few months this student changed and became confident, communicative and hard-working. Her mathematics assessments started to show good progress and a colleague regularly

made a jovial complaint that this student was gate crashing the after school mathematics revision club.

9.64 Teachers are Rude: Second Story

The class were asked to think about their initial story written at the start of the school year and now write their next chapter. They were advised that it could be a continuation of the last one or a new story, and they might like to include in their story the future in maths that they would like to have. This was the next story created by this particular student and this time she was keen that I take it and read it immediately.

> *Maths is quite interesting because it's different compared to other subjects. It involves solving equations and using logic. At times it can be difficult but I think that it is important to try your best regardless of how difficult it is. In my past, well through all my years really, maths hasn't been one of my strengths. Year 9 has been good so far and I have made good progress since year 8 but I'm determined to keep it up. In the future when I get older I'd like to think that I will aim for a B in maths. If I did I'd be proud of myself as it shows my commitment to my school work.*
>
> *I still don't know what career I would like to pursue, but I like to think that it would be a successful one. I hope to go to University and get on with education as that's my main priority for now. My goal is to make myself, my family and friends proud but most of all …… Myself.*

This student's second story surprised me almost as much as the first story. I had expected another story involving teachers and classroom behaviour, and what I got was a personal story containing reflection, growth and optimism. It was like a door had opened and allowed this student to step into the light. I have included below the last written contact with this student because it is relaxed, happy and much appreciated by me. The letter was written after I had left my role in the school. It was sent to me by the mathematics teacher who was now teaching this student.

Hi miss (my name)

I heard you're missing your classes and you might come to visit, so

I'm writing this short letter to say I can't wait to see you again.

I just wanted to say thank you because when I had you as a teacher I learnt a lot and it was a pleasure knowing you as a teacher

I hope you are feeling well

(signature)

p.s: Thank you for putting me in Miss (teacher name)'s class

To describe exactly what I did with this student during the few months after reading her first story is difficult because much of it was fairly spontaneous, just day to day dealing with situations as they arose. I have a lot of scribbled field notes which became my diary but I can outline some of the interactions. The first conversation we had that related to the contents of her story was about being rude, or in this case appearing to be rude. I was very aware that I am often perceived to be rude by both colleagues and students because I like to get to the point quickly and as honestly as I can. I had sat beside the student to discuss her work and she had turned sideways so that most of her back was facing me. I finished the conversation about her work and then asked her if she found me rude, and to scaffold the abruptness of the question I explained that I knew that sometimes people found my directness a little rude.

We discussed this point for a few minutes and she explained that she had thought that her previous mathematics teacher was very rude and she felt that she had been unfairly treated. I opened the conversation about body language talking about both my body language and hers. She was shocked that I might perceive her behaviour as rude and said that she 'was one of the quiet ones'. The conversation only lasted a few minutes and finished with a smile and a joke. The one thing that I wanted to

avoid was any upset; my only interest was to open up a communication channel. Interestingly, for a few weeks after this conversation, the student found me outside of lesson time to ask me if I really thought she was rude or badly behaved. She never turned her back on me again and although on several occasions she complained about others in the class, generally, she worked with them in a respectful collaborative way. Throughout the year her mathematics blossomed, she took control of her learning asking for extra work, communicating during lessons and taking herself to after school intervention (booster) classes, even though she had not been allocated a slot. The first few times that she went to the after school classes the teacher sent her away because a) her name was not on the list and b) the level of work was higher than her targeted level. However, she handled the problem in a very mature manner, seeking help from me and approaching this teacher again in a very polite way and eventually she was allowed to stay. At no time did she ever complain that the after school teacher was rude or unfair, and I got the feeling that she was now able to appreciate the teacher's position as well as her own.

I am not saying that there were not a few occasions when her attitude was less than perfect but I had realised after reading the story that this was actually one very nice caring person, who really wanted to get on with people but had lost her way a little and then the difficulties had escalated. Her mathematical progress during the year was considered by the school data systems to be more than would generally be expected, and in the next year she joined a larger class who were considered by the school to be on target, taught by the teacher who had been teaching the after school class. She stayed with this teacher until she took her GCSE and achieved her target grade.

9.7 Phase 3 Year 10: My Song

This story was written by a student from the year 10, phase 3 group. I have chosen this story as an example because the content started me thinking about assessments and the effect they have on students which in turn led to a discussion with other members of the mathematics department. This discussion turned into a debate and then a trial change of practice for the mathematics department. Approximately a year later, the sentiments in the story which led to a permanent change of practice for the mathematics department, also influenced a whole school policy change regarding the recording and reporting of assessments. I will expand on this later after you have read the story and the comments of a colleague. To set the scene, this student was a hardworking, good mannered student. She worked with a small group of very nice students who were all keen to do well. She asked for help when she felt she needed it although her first port of call was usually within the group that she was working with. She was chatty and she had told me that she was very keen on music and drama. The choice of a song as her story was one that reflected her interests.

Verse 1

I am confident but I still have my moment especially in maths. Year 7 I didn't mind it actually alright but maths pulled me down.

Bridge

Well some may say I need to be afraid

Of losing my grades because of what I achieve never stays the same in maths.

Verse 2

People bring me down by saying I can't do it

And sometimes I think they are right (aooohoohoo)

And also they seem to be quite rude and jealous of what I can do.

That is just me

Bridge

Well some may say I need to be afraid

Of losing all my grades because of what I achieve never stays the same but yet everything's the same in this subject.

Bridge 2

Well I want to change the way I learn. I do want to change the way I learn

In maths (x3)

I want to change the way I learn (x2)

Maths is so confusing to me (x2)

9.71 My Song Maths: Comments of a Colleague

This story was looked at by a teaching colleague who is not a mathematic s teacher and these were her comments:

Interesting choice of medium – a song

What does student mean by pull me down? Is she talking grades, mood, both? Why exactly?

Bridge – is student clear on grades, expectations, how these changes take place and why?

Verse 2 – Who is bringing her down and jealous – why link to maths only. Has she genuinely cried boo hoo. Or is this just away of expressing upset at the situation.

Bridge- slight change of wording – what does she mean about the same?

Bridge 2- step towards the positive, her wanting to change and improve. Focus on the way she learns not what she learns.

Last 3 lines – as though she has said everything and emphasises her feelings.

Maths appears confusing- what specifically?

Overall progression – child not fond of maths due to experience of perhaps low marks. Self-esteem issues about what others think.

Structure of song looks like she is seeking order and direction for her learning.

The song contains themes that refer to mathematics classroom culture. This story was interesting to me because it refers to her mathematics grades being

changeable, in fact she says ‘losing my grades’ and ‘what I achieve never stays the same’. This attracted my attention and got me thinking about grades and achievement in general. A student who has achieved a grade in their GCSE mathematics exam but actually wants to try for a higher grade has very little to lose. If they get a lower grade the next time around the highest grade is always the one that stays as their achievement. The same seems to apply in most types of assessment; you cannot lose your grade or your achievement. Yet this student can lose her grade because the internal school system reports just what they achieve in a particular internal test. There are problems with this because the tests are often put together by class teachers, they are often not suitably standardised, usually they are just testing a small section of mathematical content and in some cases tests are carried out in conditions that are not always conducive for the student to achieve their best result. After reading this story, I raised the issue of a student ‘losing their grade’ at a mathematics department meeting and the topic produced a debate that lasted for several meetings. It was eventually agreed that students should not lose their grade once a grade is recorded on the school system as an achievement, any subsequent grade or level would match or better the previously achieved grade. However students should be aware of their actual test result but it should also be explained what this means regarding a grade or level that has already been achieved. Students who are not making any effort to improve would stay at the same grade or level. After a couple of years this mathematics department policy of reporting levels or grades became school policy alongside rigorous standardisation of tests and their marking.

The second aspect of this story that caught my attention was the influence others, (including mathematics), seemed to be having on this student. Phrases such as ‘Maths pulls me down’, ‘some may say I need to be afraid’, ‘people bring me down by saying’ ,’they seem to be quite rude and jealous of what I can do’, surprised me and I started to wonder if I had missed some peer behaviour that would indicate that there was an underlying problem. This student appeared to be friendly with everybody and always worked in a group that seemed to collaborate. During the next few lessons I watched and listened to interactions that included this student but I did not notice anything concerning. Eventually I had to resort to asking her privately if she was having any problem with other students regarding her mathematics. She smiled and said thanks for asking but no, everything was fine. She explained that in her mathematics class last year a couple of the students had been very nasty to her and that they were also in this class, but it had stopped. She then talked about her previous mathematics experiences explaining that bad behaviour and calling out from other students stopped her from learning. She explained that even though the teacher dealt with it, the classroom atmosphere was unpleasant and the teacher was often cross and this student said she felt uncomfortable and could not think clearly.

This conversation encouraged me to reflect on the way I had previously dealt with bad behaviour. I had seen many lessons with a variety of strategies, some more successful than others. I had used many of these strategies myself but now I found myself considering the rest of the class before I made a decision on the best way forward with a difficult student.

9.8 Phase 3 Year 9: Amy

One day there was a girl called Amy and she wasn't really good with doing maths. She hates maths because it's complicated and it gives her a headache. But one day in school the classes changed and she had to take maths lessons. Amy was surprised, furious but also depressed.

Amy went to her first maths class, she was annoyed and angry, but suddenly she saw her best friend Silvia was in her maths class as well. Silvia is the person with them all, the smartest girl in school. Amy ran up to her saying that if she could sit next to her but then Silvia says that she hates maths as well. Amy blacked out for a moment about to sit next to Silvia then suddenly the teacher grabbed Amy's shoulder. It was Miss Robotnic.

Miss Robotnic sent Amy to the back of the room. Amy was normal on the outside but on the inside she was screaming, 'I HATE MATHS IT BRINGS ME BAD LUCK'.

Amy was at the back of the class sitting next to the girl she hates 'Sally'. Sally is a bully to Amy she always makes fun of her and calls her names and picks on her because she was a little chubby.

The first lesson was about adding and subtracting. Amy thought it mustn't be that hard but Amy just remembered that she was in a higher maths class. When the maths sheet arrived Amy could see numbers and plus and subtract signs. She was confused about the work. She looks on her right side and sees that Sally is showing off saying that she is the smartest and the prettiest. Amy was embarrassed of course; she did not know how to do anything. Miss Robotnic was looking around and she sees that Amy is stuck; she came up to Amy and helped her. Sally was giggling at Amy. Amy finally understood what to do but the class was almost done. Amy worked as hard as she could and finished as soon as the bell rang. Amy was glad because she didn't get put in catch up but Sally did and she wanted revenge.

At the playground, Amy was playing catch the ball with Silvia and then Sally stumped into the game. Silvia threw the ball to Amy but Sally caught it and threw it at Amy's stomach. Silvia was stunned. Sally was about to hit Amy but the bell went and she ran off. Two weeks later they were learning about fractions. Amy started to like maths and became smarter, she had the second highest level in the class. Sally was in the middle but she was still mad. Amy thought that fractions were the most difficult but she was the smartest at it. She helped other people because they were too confused to know, she told them it was pretty simple.

At the maths test Amy was very confident and got a high level, Silvia got the same level. Miss Robotnic was a really good teacher and she was a real friend sometimes Amy likes to call her Maria, (it's her real name), and she doesn't mind. Sally had the lowest level but she did not care about it and said she is the baddest girl in the class. After class Amy likes to clean up but Sally stayed behind, she still wanted revenge so she blew out the

holy candle and poured the candle wax on Amy's head. Amy felt like slapping Sally across the face but suddenly Miss Robotnic ran into the class and took Sally to the head teacher. Sally was excluded for at least a week and a half and Amy was glad she had maths class because her best friend was there and her favourite teacher was teaching her and she says that maths is the easiest subject (except for Art, Art is the best). Sally couldn't mess with Amy anymore because if she did she would have to leave the school.

(PS she did move schools because she put candle wax on Silvia's hand and it burnt her hand badly).

The End

9.81 My Diary Extract

How surprising this story is! In my eyes the author of the story bears little resemblance to the character portrayed in the story. Amy is exactly the type of student that would remain fairly anonymous to me in a large class situation. I would know the mathematics that was in her book and the results of assessments but very little else. When I ask myself why this happens, I cast my mind back to memories from the classroom. I remember students involved in incidents surrounding behaviour, disruption, conversations, some cheeky comments and smiling faces. I also have strong memories of students that find mathematics particularly difficult or others that have a grasp of mathematics that is profound. So what is so compelling about the story I am calling Amy?

I am not saying that I cannot tell you about Amy's mathematics and where she could improve; this is my day to day job. But, I cannot tell you why she is a member of this group of students that have slower than average progress. I cannot tell you why she appears timid in class and not confident with her words. I cannot tell you why she would work at great speed in the lesson completing more questions than any other student, but she would not stop to check that she is correct, even though she could do this quickly and easily by checking with me or with another student.

I feel I know very little about this student, she never misbehaves or speaks up, and I cannot attempt to give her any type of inspirational conversation that would appeal to her interests and perhaps help build a relationship between teacher and student.

I ask myself, can I do this with others in the class? Well yes, for some of them to a certain degree, but very much depends on their personality and the relationship they have with me, and I don't always get it right!

For me this is where the stories come in. They alert me to possible sensitive areas. They inform me of previous histories concerning mathematics. They give me a little insight about feelings towards mathematics. They help me compile a list of possible do's and don'ts with

regard to that particular student. They give me a vehicle within which to position some individual thinking about the student.

For this student, the story helped me understand how individual this student was. I had more idea what she valued and expected from her teacher. I now appreciated why it was important to her to sit in a particular place with certain students and why she was reluctant to be sat on a different table with others. I now know that she tried to give me quantity in her mathematics work to the expense of quality. The wonderful thing for me was that it was possible to address these aspects and help Amy enjoy a fruitful year learning mathematics.

Amy wrote a second story which was totally different from the first

9.82 Dream Maths

When I'm older I would mostly like to be a game creator but I would also like to be a creator or a builder. Me and my dad would always like to build things. I help him with the measuring and designing. He says that I am really great at it. If I couldn't get a job as a builder I would love to be a game creator. I don't mind to do any type of game. I might even do an educational game.

When I was a kid I always thought that I could work in a store like HMV, Clares, Toykotoys.

I still think of it, and my mum says it is a good place to earn money in the future. I would work behind the register and sell people the things they want.

Again I found this story surprising; it seemed so different from her first story. However, it did help me with my choice of classroom activities for future lessons.

9.9 Conclusion

To conclude this section of the data analysis I would like to ask teachers and educators, to think about these stories and consider what messages and change of practice each of them might incite in your day to day practice. The feedback I have given is only a snippet of the influence that each story had on my practice and my development as a thinking, reflexive teacher of mathematics. The point I would like

you to consider is: Does the use of stories, used as a classroom practice in the manner set out in this research, have the potential to address and satisfy my second research question - How can I create a more approachable and effective interface between mathematics teachers and their students?

In the next chapter I am going to look at the themes that have developed from the data over the three phases of my research looking for consistency and consonance.

Chapter 10: Themes and Summary of Findings

10.1 Introduction

Using data from each phase of the research I entered into a process of thematic analysis to draw together similarities and contradictions. The process at each stage was time consuming as it required the work to be put aside on more than once and revisited at a later date. This process of revisiting was fruitful because it allowed time for new thinking, further reading and discussions with colleagues. In this section I am going to summarise the themes from each phase and, where appropriate, look at themes that appear in more than one group. In addition, I will present the findings of colleagues when they applied a thematic analysis to a group of stories from phase 3.

10.2 Themes

After processing the phase 1 pilot themes, I realised that some of the headings, such as Powerful Mathematics, were actually ways that mathematics can be viewed and as such were subsets of a general heading which I had named The Faces of Mathematics. Working from this thinking, phase 2 produced two main umbrella themes which were, how mathematics is viewed, (The Faces of Mathematics) and the expectations surrounding learning mathematics at school, (The Culture of School Mathematics). Phase 3 also produced themes that seemed to fit under these two main headings.

10.3 Consistency and Reliability in Themes

To introduce a fresh approach to the identification of emergent themes, I asked my researcher colleagues if they would take a look at the sentences/paragraphs/ chunks

of data (appendix F) that I had used during my thematic analysis stage and organise them into groups that seemed to have something in common. These sentences were the same as the data I had used for my thematic analysis stage in which I had used a scissors to separate the stories into sentences or clusters of sentences depending on any relationship between the content. The strips of paper containing the sentences for group of students were shuffled to ensure that the selection was random and each colleague was given a pack. Everybody in this Doctorate group had some background in teaching, although not necessarily in schools and many were undertaking a qualitative study. Six people sat with the data and each came up with a set of individual themes that they felt arose from the data. They wrote their themes on post-it notes and these are represented in the table below.

Colleague A

Impact of teachers and relationship with them	Contrast It is both positive and negative at the same time.	Difficult - or expect it to be difficult - surprised if it is not.
Purpose of mathematics Exams Jobs	Status and Identity Smart Highest level Baddest	Emotional response Hate Love Enjoy Boring

Colleague B

Negative view of mathematics teacher	Change of attitude (TOWARDS MATHS)	Lack of confidence/ self-esteem	Positivity towards subject
Positive view of mathematics teacher	Enjoyment of subject	Confidence in maths	Negativity towards subject
Other			

Colleague C

What is maths to me?	Boring	Hate
	Confusing/silly/anxious	Useful/important
Reaction to the teacher	Easy/ hard	

Colleague D

Maths in relation to other subjects	Emotions	Diagnostic of problems Analytical approach
Social attitudes to mathematics	Functional aspects of maths – to help pay bills	Celebrating maths (8 fingers and 2 thumbs)
Overcoming problems Struggle and good results	Good and bad (mixed opinion)	Maths difficulty when change to secondary school
Teacher		

Colleague E

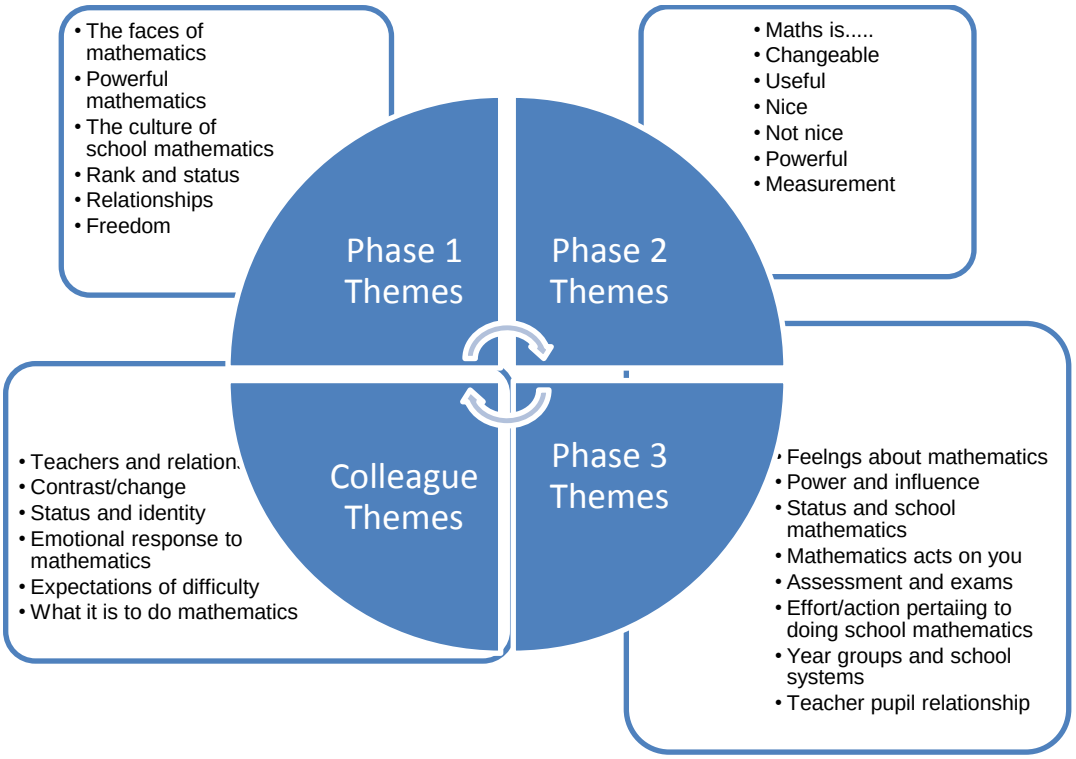
Is this maths teaching promoting learning product?
What about learning process to encourage mathematicians for the future?

Colleague F

Fear	Confidence	Uncomfortable
Distracted	Not like it	Alone

Using these post-it headings I then sorted them into categories because some of the headings were similar. I found it difficult to place the contribution of colleague E because they were questions, but felt they addressed two themes, one being the view of mathematics we adopt i.e. the purpose for learning it and would therefore address the theme that has been consistent across the data which is The Faces of Mathematics. The second area referred to was what counts as learning mathematics and links to the theme that I refer to as The Culture of School Mathematics. The themes that emerged during each phase can be seen in the diagram below.

Figure 9: Themes Diagram



10.4 Discussion of Themes

Many of the themes are repeated at each phase of the data collection. The ones that stand out are relationships, contrast and change, what mathematics is to an individual and mathematics ability to be used as a measuring device to determine institutional and psychological position. All the themes can be grouped under the original two headings of a) what we believe mathematics is about and b) the culture of school mathematics in a particular establishment. The important points that can be drawn from the themed process applied to this data is whether the mathematics that students are describing, is supportive of the ethos and beliefs about mathematics that the mathematics teachers and educational establishments wish to communicate. As colleague E asks, is this view productive to the learning and promotion of useful, functional mathematics that will support the future aspirations of these students?

10.5 Conclusion

The themed analysis of my colleagues was applied to a subset of phase 3 data, and even this small amount of the data proved to be a fairly large data set taking them some time to put their groups together. The process was very useful to me as it confirmed that there were recurring themes in the data groups, and that these themes were associated with the types of issues that had been attracting me throughout the data. Emotions featured as themes in most of the contributions from colleagues, it also had been an overwhelming factor that had drawn me to focus on particular stories, and indeed was the foundations of the adult stories that had attracted me to this topic of research. Talking about the subject of learning mathematics elicits many emotions in people and if I were to continue with this research I would want to investigate this further.

The next chapter outlines what I see as contributions to practice instigated by this research and gives some practical suggestions of how these ideas might be applied. It draws together the main conclusions of this research and suggests areas for further development.

Chapter 11: Conclusion

11.1 Introduction

A main outcome of this research has been its contribution to the task of improving practice in the mathematics classroom. Within that remit it has something to offer mathematics teachers, directors of mathematics, school leaders and teacher training educators. In addition, it has transferability; there are other school subjects and educational situations that could adopt the fundamental practices of this research to explore pupil voice and how this can inform practice. In the following section, I am going to outline where I see the research contributing and then give a brief account of how this contribution can be applied in a functional environment.

Some of the ideas I put forward have been used and others are for future development. There will be limitations on my ideas due to the limits of my teaching experience, but I am hoping that readers of this thesis will be able to see the potential of the student stories and where they could fit in their own educational developments.

Referring back to my original research questions, the first one being ‘Is learning mathematics an uncomfortable memory for a number of my students?’ This research suggests that for many of the students that took part in the story workshops there were periods of time where they felt emotions that I would understand as uncomfortable. This is also supported by adult stories that have been shared with me over a period of time. The second research question was also addressed by the research process. This question was, ‘Can mathematics teachers create a more

approachable and effective interface between themselves and their students?' I believe this research demonstrates that incorporating student stories into our mathematics curriculum plan can make a substantial and in some cases transformational improvement in the communication channels between mathematics teachers and their students.

In summary, I embarked on this research with particular aims in mind. The first was to explore the views of my students about their experiences learning mathematics and from this exploration to develop a pedagogical tool that could be used to learn more about how particular students perceive learning mathematics at school. The second aim was centred on the behaviours of mathematics classes and the difficulties that teachers of mathematics often experience when trying to address the individual needs of their students. The student stories provided a vehicle for me to investigate both of these aims, allowing me a window to access the voices of my students and then use this knowledge to critique and explore my understanding of the student learning environment. This knowledge then supported the achievement of my third aim, which was to gain a deeper understanding of the less visible influences that are at play when students take part in a mathematics lesson.

11.2 Contribution to Knowledge and Practice

The development of an emerging and personal methodology is a contribution to knowledge in this research. This broad methodology utilised aspects of action research and intuitive inquiry so that the expertise and experience of the researcher could become a relevant contribution to the research outcome. In addition the autobiographical style of report echoes the methodology of portraiture (Lawrence-

Lightfoot and Davis, 1997), and aims to make a contribution in the field of research regarding user friendly communication channels and appealing to a wide audience.

The development of a story telling workshop that is part of a planned mathematics curriculum is a particularly novel idea. There are very few opportunities in a mathematics classroom for students to constructively voice how they feel about learning mathematics, share likes and dislikes, communicate family influences and cultural beliefs and just generally talk to their teacher on their terms. The story telling workshops provide a way for this to take place in a safe, comfortable environment, using comfortable forms of communication. This research demonstrates that classroom workshops designed to elicit student stories about learning mathematics could become a very important pedagogical tool for all teachers of mathematics.

The use of pupil voice through the medium of student stories becomes a significant contribution to knowledge when used in mathematics classrooms. Creating a platform where a mathematics student can openly share their experiences, using their natural methods of communication, starts to address and add knowledge to many of the literature areas that were discussed in chapter 2. These areas include the view of mathematics that is being developed by our students, their development of mathematical identity and their beliefs about the subject, areas that become crucial information when trying to promote and develop mathematics in schools. I have found it difficult to find literature about research that describes, from a student point of view, their experiences of learning school mathematics. In general, much of the literature that I have read explores student attitude and motivation through a quantitative approach to research (Hannula, 2006, 2002; Ma and Koshor, 1997; Leder, 1985). This study contributes to knowledge by its membership of what I

believe is a lesser used qualitative approach to researching student experiences in the mathematics classroom.

A contribution to practice for this research was the application of the storytelling workshop in the mathematics classrooms, a forum where children share their stories about learning mathematics. I have evidenced in this research that this process can encourage student voice and reflexive teaching practices. Both these outcomes appear to make a significant impact on teacher/student understanding and relationship, and as such contribute to developing a more approachable and effective interface between teachers and their students.

This style of research could be used as an informative tool for school improvement. By analysing and interpreting the student stories about learning mathematics it was possible for me to use the newly gained knowledge to review the current situation with regard to how students felt learning school mathematics at my establishment. By using a similar approach, storytelling workshops could provide a tool by which teachers and educational establishments can review their own knowledge regarding the learning environment they are providing and how this might be developed further.

I would like to think that this report makes a contribution to the field of practitioner research and how it is possible to use passion and insight to improve understandings related to practice. My methodology could be described as emerging and investigative and was developed by using methods that are familiar to practitioners. An aim of my descriptions and reflexive insights was to highlight possible common ground between the expertise of the practitioner and the rigour of known academic

methods. I believe that this write-up contributes to further thinking that develops a methodology that incorporates the wisdom and strengths of practitioner with existing more traditional methodologies.

I propose that the ideas reported in this thesis could be adjusted and manipulated to suit a variety of needs and have the potential to be applied across a range of situations. In the next section I have described how the method and outcomes of student stories about learning mathematics could inform situations that are particular to my environment.

11.21 Applications for Teachers

The contribution to knowledge and practice for teachers of mathematics is in the potential that student stories present with respect to understanding the class environment and particular students. In addition, it allows mathematics teachers to analyse and critique their own practice as perceived by the students.

As demonstrated in previous chapters, the student stories contain a great deal of information regarding the view of mathematics adopted by students. The student stories give teachers a window through which they can reflect on, and critique, the face of mathematics that a student is adopting and by association the ones that various educational establishments are presenting. These may or may not include the faces of mathematics you had hoped to present to your class of students. The knowledge gained from the stories enables teachers to build on the positive faces of mathematics and present an alternative for the faces that you do not want to promote. It is my belief that our students should be aware of the multiple views about

mathematics, understanding a little about where these views might originate and the potential consequences of holding particular views. By opening the debate about mathematics, we give our students the opportunity to discuss, investigate and make selections that would be best suited to their needs. The student stories are created in a non-threatening environment using the skills and communication techniques that are comfortable to the students, and their content is an ideal starting place for promoting a human face of mathematics, one that is comfortable, accessible and aesthetically pleasing.

For me, a very important outcome of the research was the unforeseen development of a different relationship between my students and myself. I thought I knew my students fairly well and I had underestimated the scope of, what I describe now, as a really good, knowledgeable and understanding working relationship between teacher and student. It transcended the daily politics of school life and made me feel that my role as their mathematics teacher was enlightened and fulfilling. At a time when I was finding school life very hard due to bureaucracy, the boost in moral was a welcome and surprising addition.

Another beneficial outcome of this research was how this new knowledge about my students helped me plan effectively for their particular needs, many of which were not entirely mathematical. This research was originally developed to investigate my observations that for some school students and adults, the mention of mathematics brought about negative emotions and often a change in behaviour. In addition, they often attributed teachers or school as contributing to a miserable experience learning

mathematics. My student stories were full of information relating to how students felt in mathematics and what events had influenced their mathematical lives. I found that once I knew these student stories, my planning for the class changed dramatically, I could really plan with differentiation, not just mathematical content differentiation but differentiation by task or language or simply by classroom management.

11.22 Applications for Mathematics Departments

The contribution this research offers to mathematics departments is in its potential to develop reflexive mathematics teachers who can succinctly judge the best way of developing their class of potential mathematicians. In addition, it allows mathematics departments to investigate the ethos and opinions that mathematics students are developing about mathematics, giving them useful feedback which can enhance department development.

The student stories are a good gauge for a mathematics department to investigate how mathematics is perceived in their school. It is a useful exercise to see how this relates to the mathematics department ethos and the school ethos. It may be that a department decides to positively promote aspects of its ethos once they have information from the stories. I have to say a word of caution at this point- asking a class to share their stories is not something that should be undertaken by all mathematics teachers, for some it would not be a way that they would like to work and this opinion must be respected. I realise that sharing the mathematical stories of your class with other mathematics teachers and your boss could make a mathematics teacher feel vulnerable. I found it impossible when I read the stories, not to worry that every negative aspect in the story was my fault. However, these

students have had many different teachers and most have had experience of another school. The story and their events are a mesh of histories and experiences, and the end story is likely to be a departure from accurate accounts of classroom life. The importance of the stories is that they convey feelings, messages, likes and dislikes about mathematics and are not an account of who did what and where. The students must be protected and kept anonymous, and for this reason it would be important to compile general themes that occurred in the stories to highlight at department discussions.

In my role as a department leader, there were some aspects in my student stories that I found were food for thought and contributed to department and school development. I will only mention a couple here as they are specific to the institution and not necessarily transferable. The first was a theme running through the pilot stage of the data collection which I felt was related to an institutional problem rather than a specific mathematics problem. Many stories referred to having a large number of mathematics teachers and they indicated that this was not desirable. This point was also mentioned a few times in other phases but was always specific to the class. Some classes had experienced a large turnover of mathematics teachers in a short period of time. Nationally there is a shortage of mathematics teachers and the school had a period of two years when there were unforeseeable problems with staffing in the mathematics department and hence a string of supply teachers. Although at the time the events were out of my control, it encouraged me to think about how the classes felt about teachers in general. I got the impression that it was important to them to have a teacher that they could call their own; they did not seem to reflect particularly on the ability of their mathematics teacher just the stability. This point

was reflected in the future planning of the department with respect to staffing and the changing of teachers during the academic year.

The second department influence that I would like to mention is the reference in the stories to the changeability of mathematics and in particular a student losing their knowledge or their grade. This idea that you could go backwards in your grade or level fuelled a department debate for a considerable time, and we concluded that in general, if you had achieved something in the world outside of the classroom, an example would be passing your driving test or a particular performance in athletics, that was recognised by all as an accomplishment, it would be exceptional circumstances for you to 'lose' it. Yet in mathematics it seemed that you could lose your accomplishment in the next assessment. Eventually, it was agreed in the mathematics department that if a student had achieved a level in mathematics, for example 5a, as a formal recorded assessment, then that grade or level would hold or could only be improved on. Therefore, in subsequent assessments, if the student achieved a lower grade or level it would be reported to the student and home as a need for improvement but the school system would hold the original higher grade. This made allowances for the student having a bad day or other unforeseeable circumstances when taking an assessment but allowed the student to experience stability in their recorded assessment performance. This department policy was later developed as a whole school policy and is still being used at the present time.

11.23 Applications for School Leaders

My contribution to knowledge and practice for school leaders is a model of classroom practice that can aid staff development, encourage pupil voice and help promote a current, positive mathematical ethos throughout their establishment.

Allowing the time for mathematics teachers to develop their student stories can have benefits in two main ways. The first is the development of student voice in what is often seen as a less accessible subject, one that the students often register that they are having difficulties with. The second is the potential that the communication of stories has to improve the planning and practice of mathematics teachers, which in turn can lead to a more equitable enhanced curriculum, a cohesive and functional classroom atmosphere and improved moral of the mathematics department.

11.24 Teacher Training.

The concept of student stories is a useful and informative tool for developing reflexive practice with trainee teachers. The work with student stories reinforces the fact that teachers never stop learning about their students, it dispels any notions of infallibility and helps develop a knowledgeable and empathetic approach with mathematics learners. The student stories will add information to any discussion and critique regarding the values and assumptions of the classroom teacher. Promoting the development of student stories encourages adaptable teaching with a view to questioning what we are teaching and why. I believe that encouraging trainee teachers to think deeply about their practice and the influence they have on their students will promote a culture of thinking, caring individuals who are proud of the work they do.

11.3 Concluding Discussion

To conclude this section I would like to add a claim that the sharing of student stories can be linked to improved mathematics performance for many of the authors. For the groups in phase 3, when the stories were written early in their academic year the following effects were noticeable: a) Sharing these stories seemed to have a calming effect on the classroom behaviour of several of their authors, this also contributed to improving the work ethos of the class and collaborative ways of working with peers; b) Many students developed a more mature approach to their mathematics learning and how they dealt with subsequent problems, and c) communication between the students and the teacher, me, was easier and most of the students made excellent progress throughout the year.

My aim has been to communicate this research as openly and honestly as possible. The ideas and references are supported by extensive reading, thinking and a personal reflexive debate on my years of teaching mathematics in school. I would hope that my contribution to the academic world of research is by highlighting the place of accessible, reflexive, self-critical, action research. Research that has an intention to serve the community that it is in relationship with, and has a desire to encourage empathy and equitable behaviour when interacting with others.

I champion the recognition of intuition when dealing with qualitative data that is collected by a researcher that adopts an insider approach, and would suggest that intuition infiltrates all data recognition and decisions in this situation.

In this research I have drawn strands of meaning from children's stories, confirmed these strands of meaning by looking for duplication in other forms of data, and synthesized these findings into a narrative thread, a construction of meaning that can inform a public debate that can be used to understand and improve the teaching and learning of mathematics in schools. The storytelling workshop is a reflexive tool that can be used in empathetic classrooms where the teacher has a commitment to improve his or her own practice by understanding more about a) the needs of their students (not just mathematical but mathematically related), b) the implications of his or her own perceptions and actions, and c) promoting student voice and confidence.

I entered into this research with little idea of what to expect, and my key concerns were whether students would take part in a storytelling workshop and if they did, would they produce something that I could engage with. In conclusion my key findings were as follows:

1) Students shared their stories in a comfortable, eager manner indicating to me that storytelling as a classroom practice has the potential to be an effective tool to communicate student voice and inform teacher knowledge. In addition, there is a suggestion in phase 3 that the process of storytelling facilitated some students to reflect on their views regarding mathematics and reconcile social difficulties when learning mathematics.
2) It is possible, through the sharing of stories, for teachers and students of mathematics to create a relationship which promotes learning and understanding surrounding the topic of learning mathematics. This outcome was particularly useful where the student had communicated aspects of mathematics classroom culture and their expectations about mathematics.

3) The student stories highlighted a variety of perspectives by which mathematics could be viewed. This insight into how our students think about mathematics has the potential for institutions to promote emancipatory and positive views about mathematics, and debate and analyse less productive views.
4) The process of thematic analysis highlighted areas that were featured throughout the phases. Specific examples of this were: confusion and discomfort surrounding change and transitions of school, year group and teacher; a variety of ways of recognising what mathematics is; particular expectations of the role of the mathematics teacher and the place of exams, tests and their results as a measure of learning and ability in mathematics. Particular themes running through groups of stories could be a very useful way for institutions, departments and teachers to critique and develop their mathematics ethos and practices. Through the medium of student stories, teachers can undertake critical reflexive reviews regarding the ethos they promote, the fairness of their classroom practices and the general environment that they ask their students to work in.

11.4 Limitations of this Research

A particlar limitation of this reseach for me was the depth of emotion and responsibility that I started to feel for my students. It was an unexpected by-product of developing the student stories with a class and yet, perhaps, I should have known it would happen. I have been, and still am, a subject of the research. The topic of this research has been part of my life since I can remember and the methodology design draws me into centre stage, deciding which paths and doors should be

recognised. I feel the need to have a voice in the research because I feel a vulnerable part of the community of teachers that this research targets as its audience. Behar (2014) described the place of the vulnerable observer as one who makes their emotions part of the research, with a warning that ‘the exposure of oneself who is also a spectator has to take us somewhere we coundn’t otherwise get to’ (Behar, 2014:14). In the words of Romanyshyn (2007) there is something of the unfinished business in this research and he argues that the completion of the work by a reseacher is not the end of the work.

> Research with soul in mind is re-search, a process of re-turning to, and re-membering what has already made its claim apon the researcher through his or her complex relationship with the topic Romanyshyn (2007: xi).

I found the research overtook my life somewhat, thwarting me with feelings of guilt when I was not working on it. My research participants became the centre point of my thinking and I worried about them when they moved on to another teacher or educational establishment. I found that once I read their stories I was commissioned to give them an improved classroom environment and a more knowledgeable teacher. This intense feeling of responsibility made the research slower and harder to process and elongated the writing process because I had to keep revisiting the work ensuring that my thoughts and conclusions were accurate and in the interest of the story authors rather than my own.

The research work conducted with my colleagues facilitating their storytelling workshop, served its purpose to show that it could be a tool for other teachers to use. The feedback from these teachers was very positive and both said that they felt they could learn a lot about their students through the medium of student stories.

Students were reluctant to take part in interviews about their stories and in hindsight this is not surprising. The relationship between student and teacher is not as an equal and is often an uneasy one. The storytelling workshop was fairly personal for students and although they shared their stories with me, they did not have to be there when I read them. It was then a big step to sit in front of me, their mathematics teacher, and openly talk about these stories. In hindsight student feedback could have been planned using a less intrusive format, an example might be asking students to feedback at the end of the workshop using post it notes that can be placed anonymously on a classroom surface.

Some students did not share stories and used the time to work on other tasks. At each workshop an area had been set up with a range of different mathematical tasks that students might like to work on if they did not want to share their stories. The tasks were differentiated, and used a variety of skills that would complement their mathematical learning. Some were formal classroom tasks, others were tactile learning tasks using shape and space ideas and others were mathematical games and puzzles. I was also prepared to sit with these students supporting their chosen work. Although throughout the whole process only two students actually said they did not want to take part, others made mathematical posters that took the place of the stories. If the research looks at the stories as a classroom tool to improve the provision for students then the exclusion of these students would need to be addressed. In the case of my students that did not share a story, I chose not to ask them questions relating to why they did not share their story because I felt that they might find that intrusive. Instead I made a conscious effort to work closely with them

over the next few weeks and by doing this I hoped to be able to make some progress with understanding their individual needs in the mathematics classroom.

This is a particular type of research in a particular context, and I believe the shape it takes is very much dictated by the personality of the researcher. This makes repeating the process in a different situation complex and I imagine the write-up would look very different. The particular knowledge produced regarding the content of the stories might not generalise and the methods of the workshops might not exactly replicate. This said, I believe the foundations of the research would hold fast encouraging student voice and transformation, reflexive practices and a more enlightened relationship between the researchers and those researched.

Another particular limitation of this research was the time allocated for the workshops and the fact that due to their absence some students did not complete their stories. During phase 1, I struggled with the idea of using mathematics lesson time to facilitate the workshops. This is because during my teaching career I had always argued that mathematics lesson time should be devoted to doing mathematics, particularly when lessons were being used for school business. After phase 1 was completed, I started to understand the power and scope of the stories, appreciating that they made a valuable contribution to the functioning of the mathematics classroom. In hindsight, some students needed a little flexibility in the length of the workshops, allowing some students to take a little more time on their stories and thus accommodating their absences.

11.5 The importance of this Research

This research has highlighted that students respond to school mathematics in a variety of ways. Within the stories are descriptions of experiences, some that could be described as positive and others that seem negative. Reiss et al (2011:274) concluded that understanding these varied responses to school mathematics 'may make sense of the peculiarities of how different students react to school mathematics'. The concern of Reiss et al (2011), was with the lack of post-16 participation in mathematics and physics, and stated that even the students who have done well in school mathematics often do not continue with it. Student stories about learning mathematics can give teachers an insight into how students feel when learning mathematics in school and help them make recommendations about possible interventions, new initiatives and informed practices leading to a more positive, enjoyable learning experience.

In the study relating to student attitude towards mathematics and achievement in mathematics, Watts (2000) found that there was a strong positive correlation between the two. Nardi and Steward (2003) also pointed out that the strong links between attitude and performance make research in this area essential. In their research account (Nardi and Steward, 2003), they found that students want classroom mathematical experiences that are tailored to their individual needs and that in the absence of this individualism they grow alienated from the subject, losing their sense of intellectual satisfaction and enjoyment. I feel that culturally, for many students, school mathematics has an elitist undertone promoted by the focus on rank and position as a measure of ability and intelligence. In addition, the use of expert

language can limit a student's power of communication making the school mathematics classroom a place where individualism is tricky, both for the student to show and for a teacher to nurture. The student stories help bridge this difficult situation by allowing students to speak in a chosen medium and teachers to see more than just the mathematics on display.

11.6 For the Future

My vision is that future research will utilise the storytelling workshop in order to form strategies that will help learners of mathematics and mathematics teachers function more effectively in the school mathematics classroom. I would be very interested to see a research study where the storytelling workshops are adopted as a department practice, and the research data is a study of the subsequent changes this practice brings about for all its investors.

For myself, I would like to disseminate the ideas and findings that have emerged in this research through the medium of publication, conference presentation and workshops. I would particularly like to work in collaboration with mathematics departments and teacher education establishments that have a focus on promoting positivity, intellectual satisfaction and enjoyment in the mathematics classroom.

I would like to carry on studying student stories and in particular investigating the relationship between the faces mathematics presents, what a student might perceive as a public and private face of mathematics (Fried, 2008), and how this impacts on their perception of mathematics as inconsistent and changeable. I am convinced that a particular understanding of these influences would be informative and beneficial to all who design mathematics curriculum and subsequent mathematical interactions.

Finally, on a personal basis, the findings of this research have provided me with knowledge that I consider as invaluable. I believe there is much work to be done if we want our adults to recall more open positive stories about learning mathematics in school and I would like to end with the inclusion of an adult story (appendix G). This was written by one of the research participants after they had finished learning mathematics at school. It was a story offered without any prompt from me and I include it because it is typical of many of the adult stories that I have heard over the years, yet it has a level of analysis about her struggle with mathematics that I find interesting and enlightening. This story gives me the impression that this student has come to terms with her position with regard to mathematics, and her sentiments promote the need for a more human face of mathematics that can celebrate a range of personalities and talents. This closing story makes me confident that the practice of sharing student stories can help encourage a calm, holistic attitude to learning school mathematics presenting a human face that can be accessible to all types of learners.

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List of figures

Appendix A Ethics Application

Protocol No: *11-12.2*

UNIVERSITY OF HERTFORDSHIRE
FACULTY OF HUMANITIES, LAW AND EDUCATION
ETHICS COMMITTEE

Application for approval of a study programme involving human informants

This form should be completed in conformity with the Faculty's Principles for Conducting Research involving Human Informants. It should be used by individual applicants, staff or students, who require protocol approval for work which they themselves intend to carry out in the session 2010 - 2011.

Please word-process this document.

1. Title of programme:
What is in the baggage children bring to the mathematics classroom?

2. Applicant's name

Jean Brennan

Status
Postgraduate, part time
Student no. 09249037

Scheme of study or award

EdD, Schedule: H EdD/MPhil

E-mail address::

brennanjean1@gmail.com

Name/s of supervisor/s

Ms Bushra Connors
Prof. Alan Davies

3. Chair of Faculty/Departmental Ethics Committee or Chair of Faculty/Departmental Research Committee

Dr Tim Parke

Research aims of the programme:

The aim of this research is to develop a deeper understanding of how some students deal with school mathematics by exploring a) the barriers to learning mathematics, b) how a student's perception about the nature of mathematics and
what constitutes mathematics, affects their ability to function in the mathematics classroom, and c) how the notion of mathematical identity affects learning.

This research is a qualitative study that sets out to explore the mathematical lives of secondary school students. The study is working on two layers; one layer will be used to pilot and develop techniques that will help adolescent mathematic students develop a voice that enables them to communicate their affective, and sometimes unspoken, thoughts and feelings about mathematics, the other sets out to look deeply into the experiences of a few students. This study aims to maximize opportunities for children to communicate in their own individual and unique way, the meanings they have created about mathematics. With this in mind I am looking at data collection methods that will allow all abilities and talents, the freedom to communicate in the method most comfortable to them.

3. Number of informants

Students: 150 aged between 12 and 17.

Adults: 14, 6 teachers currently working in secondary school, and 8 parents.

Nature of informants

The sample will consist of:
3 London secondary schools
A maximum of 150 school children between the ages of 12 and 17.
A parent/guardian of 8 of the above students.
Six teachers who work with the above age groups

Sample selection

For phase one the sample of children involved in the research will be classes I teach.

The mathematics teachers in phase one will be colleagues in my school.

4. Has confirmation been obtained that the informants required will be available?

No.

Information regarding this research project and letters asking for permission to include students in the project are due to be sent out to parents at the start of the school year (January 2012 pending ethics approval).

The students will also be given information about the project on each data collection occasion and the opportunity to withdraw from the process.

See attached letter and leaflet.

8. Probable duration of investigation:

October 2011 to *July 2014 inclusive*

9. Where will the study take place?

The phase 1 study will take place in an Inner London girl's secondary school (Maria Fidelis School). It is an 11 – 18 voluntary aided secondary school. It is in the education borough of Camden and its location is in Euston NW1. The location of subsequent phases will be dependent on permission to access similar schools. At present, I have had an interest from the Head teacher of St Annes Secondary school in Palmers Green, London, but as yet I have made no formal approach to the Heads of any other schools.

10. Describe the procedures to be used. Give sufficient detail for the Committee to be clear what is involved in the programme, continuing on a separate sheet if necessary.

Phase one data collection events

Student workshops

3 Interviews with volunteer students (20 minutes long)

Informal discussions with colleagues

Phase two data collection events

Building on the findings of the phase one study, I plan to investigate similar issues with a wider sample of adolescent students. The intention is to;

a) Use the methodological tools trialled and developed in phase one with a wider sample of students (age 12 – 15);
b) Interview colleagues in other schools.

Ethical considerations

Story telling workshop

I will record a copy of the student stories. Student body language including laughter, hesitation and any observed emotion .A record of my instructions, and any reflections on the process.

Students may, if they wish make a video of their work. This will only feature the students work and a voice (not an image of the student), will only be used for purposes of accurate interpretation and will not be viewed by anyone other than the student that has produced it and myself. Once the data analysis is finished the videos will be destroyed by me (6 months after the story telling workshop).

Interviews

I will make records of conversation, the setting and organization (including my performance), student body language, laughter, hesitation, and any emotion observed.

If consent is given by the participant the interview will be taped to allow accuracy of recall. The interviews will take place in the school library when it is free from other students. This is a comfortable, windowed room, there is always a librarian present but they will not be close enough to hear the interview. Once interview transcripts are written tapes will be destroyed).

Security

Data will be locked in a secure storage environment and will not be accessible by any other person than myself. Data will be shredded on completion of my thesis and this will be no later than December 2014.

The report

The report is for the purpose of communicating the research findings. It will be used in my dissertation. My expectation is that aspects of the report will be disseminated to parents, school governors, mathematics teachers, teaching assistants and training bodies in the form of a published paper and/or seminars. As these are all public domains I am aware that the privacy of

individuals is respected by; a) preserving anonymity and b) respecting confidentiality even when this results in seemingly important data being omitted from the report. In the case of participant adults I will make a draft copy of the report available before it is finalised.

Organisation of consent

Prior to commencing each phase of my research, permission to undertake the research will be sort from the head teacher and governors of the school. The aim and design of the research will be explained as fully as possible, who the potential participants are and what the possible safeguards will be. They will also be assured that in all research reports the school will be anonymous, and participant identities and contributions kept anonymous and confidential.

A letter of information will be provided for the parent or guardian of all the students that are invited to take part and informed consent will be requested. They will also be able to contact me for further clarification, and in all cases confidentiality will be explained and guaranteed. Any decision not to take part will be treated with integrity and respect.

Students will be asked in writing and in person if they would like to contribute to the data collection process, and what is involved will be clearly set out in both forms of communication. It will be made clear that they do not have to take part, and if they do choose to help me with my research that they can withdraw that offer at any time.

When inviting the students to participate, care will be taken to ensure that they feel no pressure to take part. The purpose and content of the activities will be explained to the potential participants, and my position as a researcher will be explained. The participants will be given time to think about the proposal, have clear guidelines about how to seek more information and will have a stress free way to contact me in the event of any problems. A debrief session will be included in the planning to allow students to ask questions, clarify their position and develop an understanding of their part in the research process. All participants will have the opportunity to hear the

research outcomes and discuss any subsequent issues. Any negativity caused by the process will be addressed and future planning will aim to safeguard against repetition of this. If there is an objection to any data this will be considered and may result in that data being withdrawn?

Students and colleagues will be advised that during the research references made to participants will be anonymous, replacing participant names with an alternative such as student A etc.

Data collected from colleagues.

I will adopt an informal approach when talking with mathematics teachers, making use of convenient opportunities. With their permission, I will attempt to write accurate accounts of the discussion, and in each case I will ask them to check the accuracy of the account.

11. Might the study cause discomfort or distress of a mental or emotional character?

Care has been taken to ensure that no participant suffers discomfort during or after the research, however, if this occurs the process will be stopped and I will talk through the cause of the discomfort with the student. I will inform their parent/guardian of the situation, and If needed, I will seek advice from the school duty of care system that have the expertise to help.

12. If the answer to question 11 was YES:

i) is it likely that medical, therapeutic or other aftercare may be needed by informants?

NO

13.(a) Will explicit consent need to be obtained from (or on behalf of) the informants?

Yes, letter and leaflet attached.

(b) How long before they take part in the investigation will informants' consent be sought?

Two weeks

(c) What will informants be told as to the nature of the investigation?

See leaflet

(d) Will informants be given an opportunity to put questions to the investigator, arising from what they have been told?

YES

(e) Will informants' consent be requested:

i) **after they have been briefed in writing?**

Yes, at the start of each activity.

after oral briefing?

14. If the informant is a minor, or otherwise unable for any reason to give full consent on their own, state whose consent will be obtained (parent and/or guardian and/or head teacher and/or other (to be specified) and how it will be obtained.

For all minors, consent will be sought from a parent or carer.

15.(a) Is the investigator receiving any financial or other reward connected with this project?

NO

(b) Will anyone else receive any financial or other reward connected with this project?

NO

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16. Are personal data of any sort (including name, age, sex, occupation, etc.) to be obtained from or in respect of any of the informants?

The age (in years) of the student taking part in the research and their gender may be pertinent to the findings, however as there are a number of students of the same age taking part no students can be identified by age. Names will not be included and students will be referred to as student A etc.

The occupation of some adults will be important as they will predominantly work as mathematics teachers. Teaching assistants will also be referred to as mathematics teachers for the purpose of this result. Names will not be included and teachers will be referred to as teacher A etc.

Parents will be assigned as parent A, (linked with student A). The gender of the parent will also be reported for purposes of clarity. Gender is not a feature of this research but it is possible that certain data may open doors for further research work. Participants will be protected from any discomfort.

17. Any other relevant matters?

No

18. DECLARATION BY APPLICANT

(i) I confirm that, in formulating the above proposal, I have complied with the following ethical code(s).
*(Specify here the code(s), other than the **faculty principles** alluded to above that you have adhered to in designing the investigation).*

(ii) I undertake to abide by the Ethical Principles of the Faculty of Humanities, Law and Education to the best of my ability in carrying out or supervising this programme.

(iii) Data relating to identifiable informants will be treated as confidential and not passed on to others without the written consent of the informant. Where the informant is a minor, or is otherwise unable for any reason to give full consent on her/ his own, or to receive full explanation of the nature of the investigation and its risks, *informant* in this context will be understood as referring to the person or persons having responsibility for the actual informant in the investigation (see section 16 above).

(iv) The nature of the investigation and all possible risks will be fully explained to potential informants. Where the informant is a minor, or is otherwise unable for any reason to give full consent on her / his own, or to receive full explanation of the nature of the investigation and its risks, then *informant* will be understood as referring to the person or persons having responsibility for the actual informant in the investigation (see section 13 above).

(v) Where appropriate all informants will be informed that they

(a) are not obliged to take part

and

(b) may withdraw from the programme at any time without disadvantage, or having to give a reason.

Name of applicant

Jean Brennan

Signature of applicant **Date** 13/12/2011

In the case of an individual applicant this form MUST also be signed by the applicant's supervisor.

19. DECLARATION BY SUPERVISOR

I confirm that the proposed study has been appropriately vetted within the Faculty in respect of its aims and methods as a piece of research; that I have discussed this application for Ethics Committee approval with the applicant and approve its submission; and that I accept responsibility for guiding the applicant so as to ensure

compliance with the terms of the protocol and with any applicable Code(s) of Practice.

Name of Supervisor …Bushra Connors

Signature of Supervisor …….

Date ……10/10/2011

Appendix B Workshop Starting Points

Starting points for pilot story telling workshop: What was said to the students.

Everyone has memories, from home and school, from friends and enemies. These memories tend to get hidden away and are rarely shared with other people. I would like you to think back about something memorable in mathematics and represent it in a story, or a picture or cartoon, or even a drama. It could be a good or bad event that you remember, it could be how you feel in general about mathematics or you could tell a story about your dealings with a mathematical topic either in school or out of school. Try to tell your story in which ever way you feel most comfortable, you can work on your own or with others, you can make it amusing or serious, it is entirely up to you. If you are talking about a person, give them a fictitious name; remember it is all about the story not the people so try to keep it anonymous. The story will not be shared with other people in school and you can choose at the end to keep it to yourself and not show it to me.

Starting points for phase two workshop and the workshops of my colleagues

Year 11

Story telling workshop

I would like you to spend a little time thinking about your experiences of mathematics.

Memories from when you were younger

Memories from more recent experiences

Good/ bad feelings

Good/ bad experiences

Successful/ unsuccessful times

Happy/ sad times

What your parents/teachers/friends say about maths

Maths in and out of school

What you think

I would like you to make a story about **your** mathematical world.

Use some of the starting points above to create **your** story

It can be a piece of writing, drawing or cartoon, a song, a poem or a drama.

Keep the story anonymous by using fictional names

To encourage the students to engage in a story telling frame of mind I decided to read them an extract from the The Curious incident of the dog in the Night- Time (Haddon 2003: 56). It is a book that I wanted to encourage my students to read and had many positive references about mathematics.

Story telling workshop action plan

Aims:

<table>
<tr><td colspan="2">To create a vehicle for students to express and explore their feelings and beliefs regarding the nature of mathematics and their learning of mathematics.</td></tr>
<tr><td colspan="2">Objectives:
Students explore and communicate their experiences, feelings and/of beliefs about mathematics.
Students understand the possible roots of any influences and emotions that may surface when people are learning mathematics.
Students deepen their understanding of social, cultural and political influences that may influence the learning of mathematics for some people.
Students are aware of who they are and who they want to be in the world of mathematics (i.e. their mathematical identity)</td></tr>
<tr><td>Activity schedule</td><td>Timescale</td></tr>
<tr><td>Story telling workshop:

Students develop stories in a way that appeals to them, students have the opportunity to use the flip cameras to talk about their story creation.</td><td>2 lessons plus some home time in between. (3 hours)</td></tr>
<tr><td>My reading of story, initial interpretation and compilation of questions.</td><td>Two weeks</td></tr>
<tr><td colspan="2">Student evaluation of the process – possibly an evaluation sheet. Timescale to be decided.</td></tr>
<tr><td>Interviews with some students regarding their stories</td><td>20 minutes per student

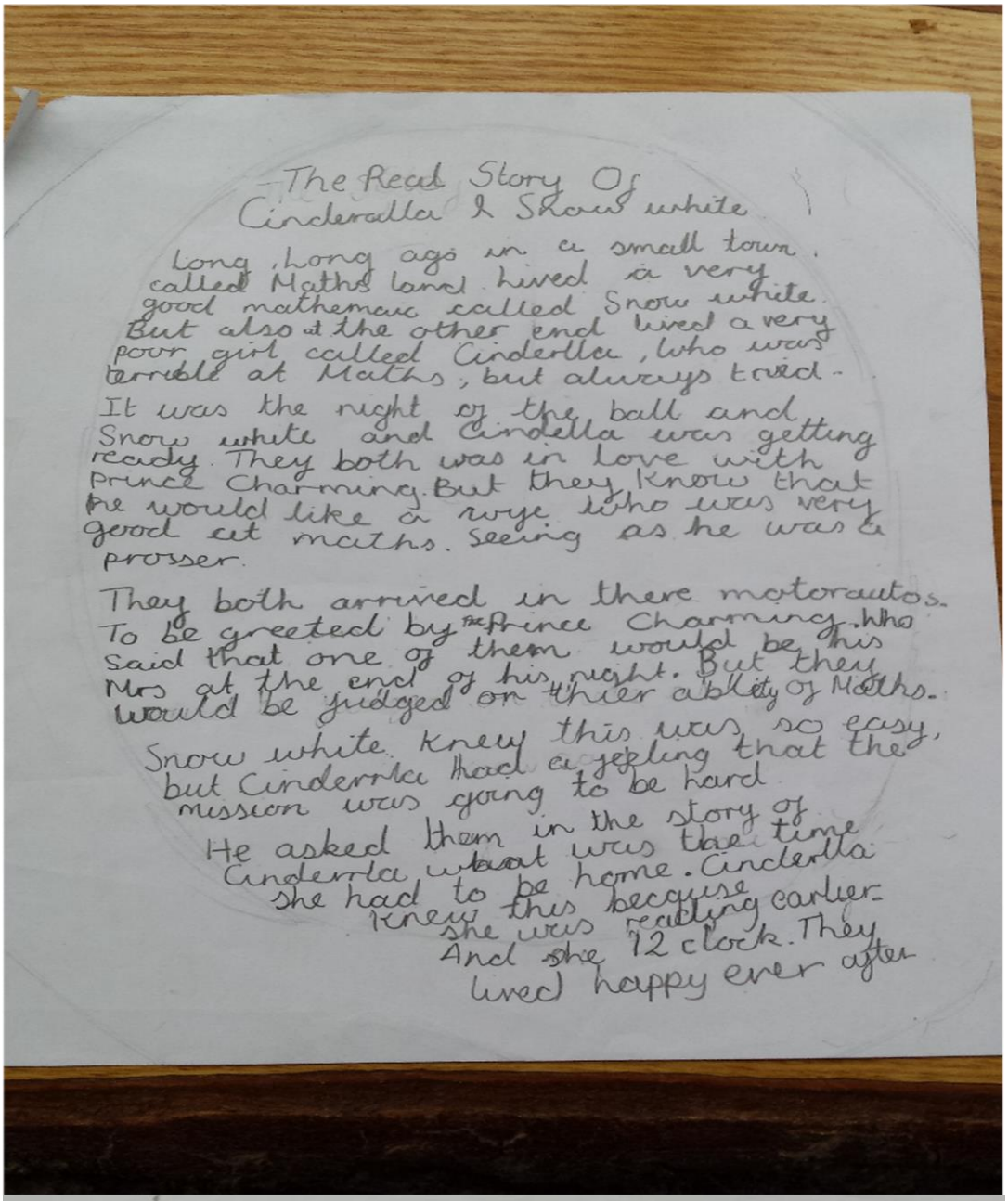
Allow 3 weeks</td></tr>
<tr><td colspan="2">Time allowed to go through interview data and compile follow up questions, and for students to ask subsequent questions. One week</td></tr>
<tr><td colspan="2">Total time for activity. Approximately two months</td></tr>
</table>

Appendix C: Pilot Study Stories (Note: All teacher and student names are fictitious)

Story 1 PhD

Story 2 Swiss Roll

Story 3 Cinderella



The Real Story Of
Cinderella & Snow white

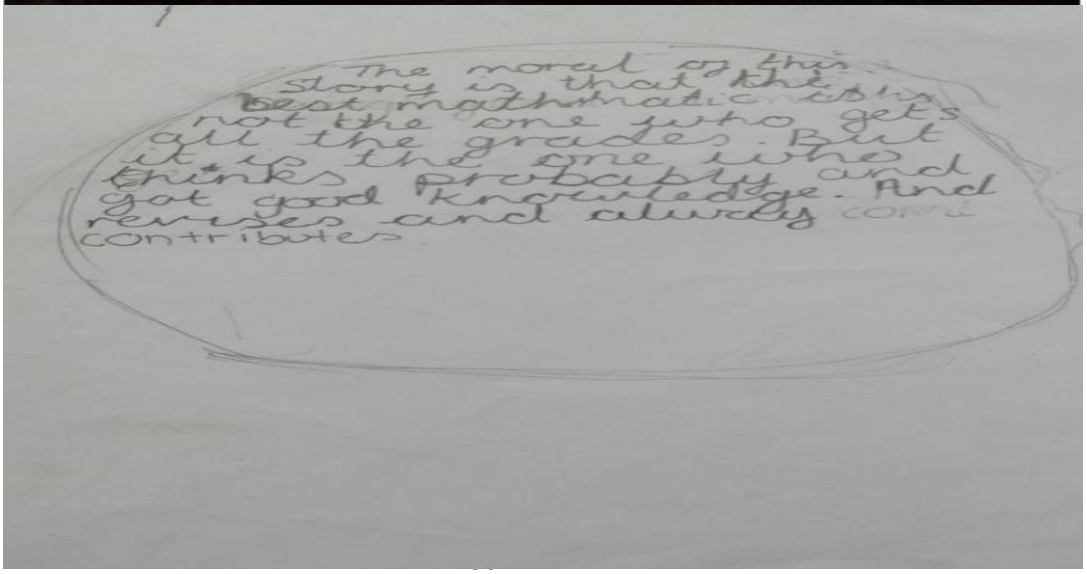
Long, long ago in a small town called Maths land lived a very good mathemaic called Snow white. But also at the other end lived a very poor girl called Cinderella, who was terrible at Maths, but always tried.

It was the night of the ball and Snow white and Cindella was getting ready. They both was in love with prince Charming. But they know that he would like a boye who was very good at maths. seeing as he was a prosser.

They both arrived in there motorautos. To be greeted by the prince Charming. Who said that one of them would be his Mrs at the end of his night. But they would be judged on thier ablety of Maths.

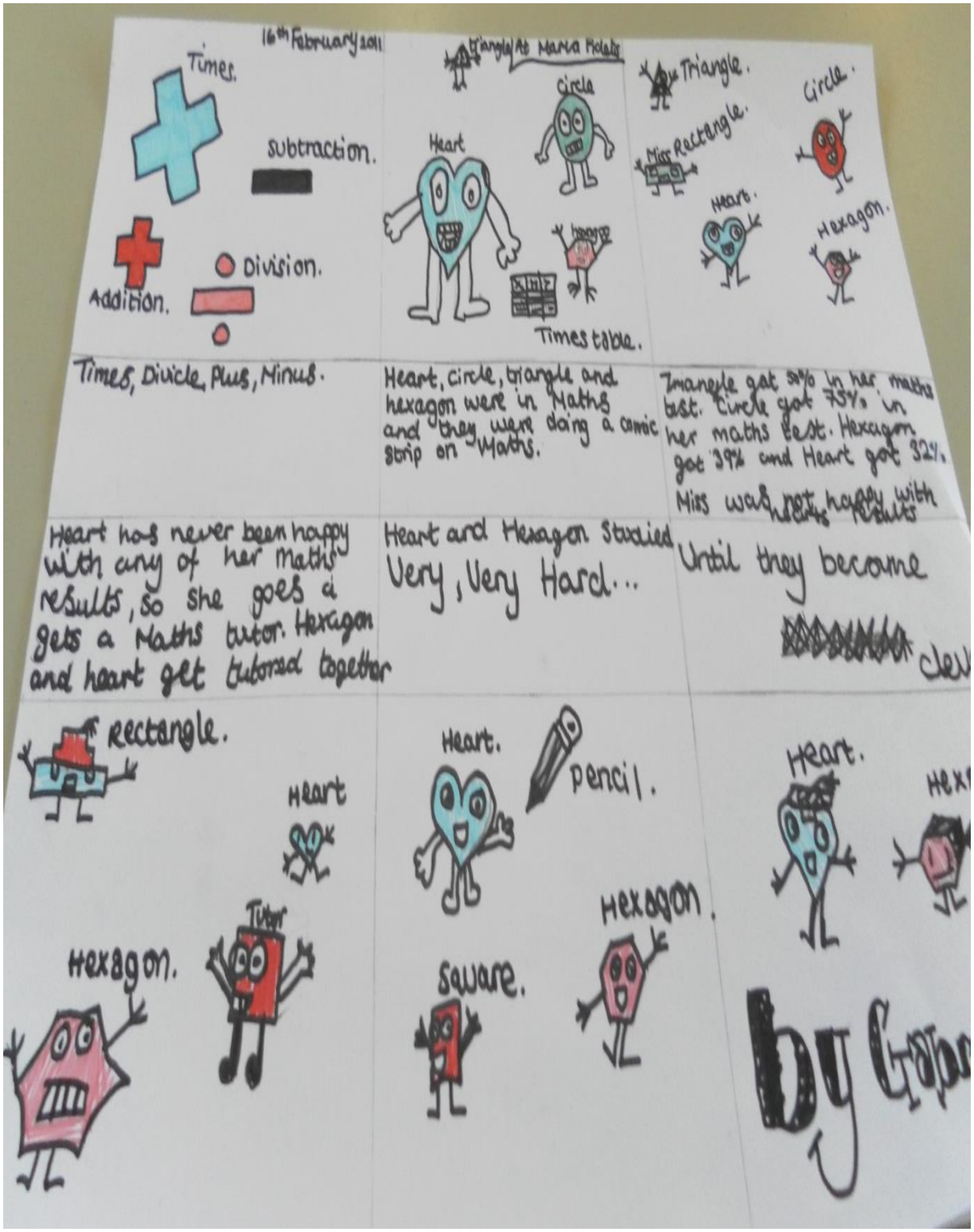
Snow white knew this was so easy, but Cinderrla had a jeeling that the mission was going to be hard

He asked them in the story of Cinderrla what was that time she had to be home. Cinderella knew this because she was reading earlier. And she 12 clock. They lived happy ever after



The moral of this story is that the best mathmatic isn't not the one who gets all the grades. But it is the one who thinks probably and got good knowledge. And revises and always contributes

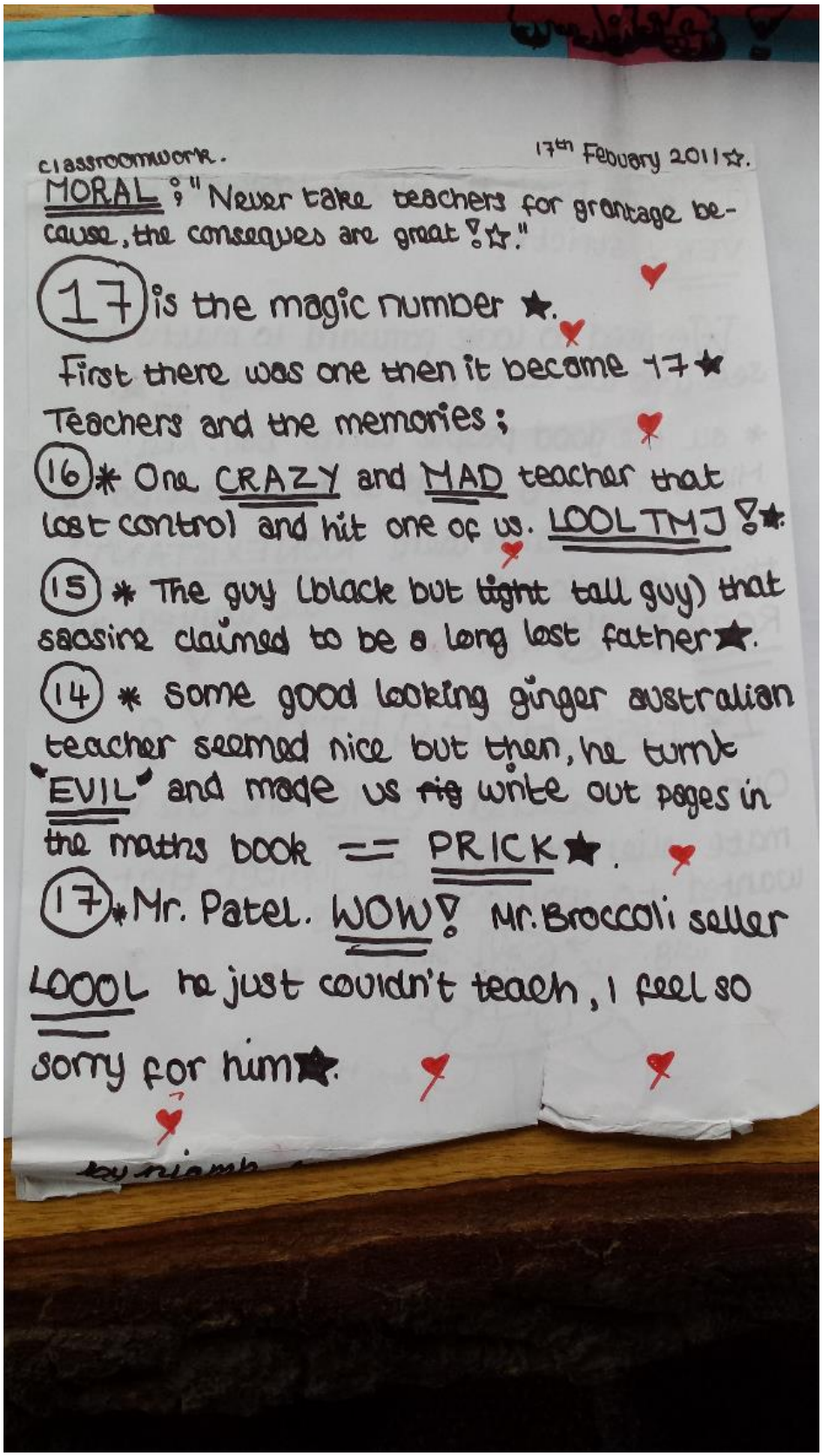
Story 4 Heart



Story 5

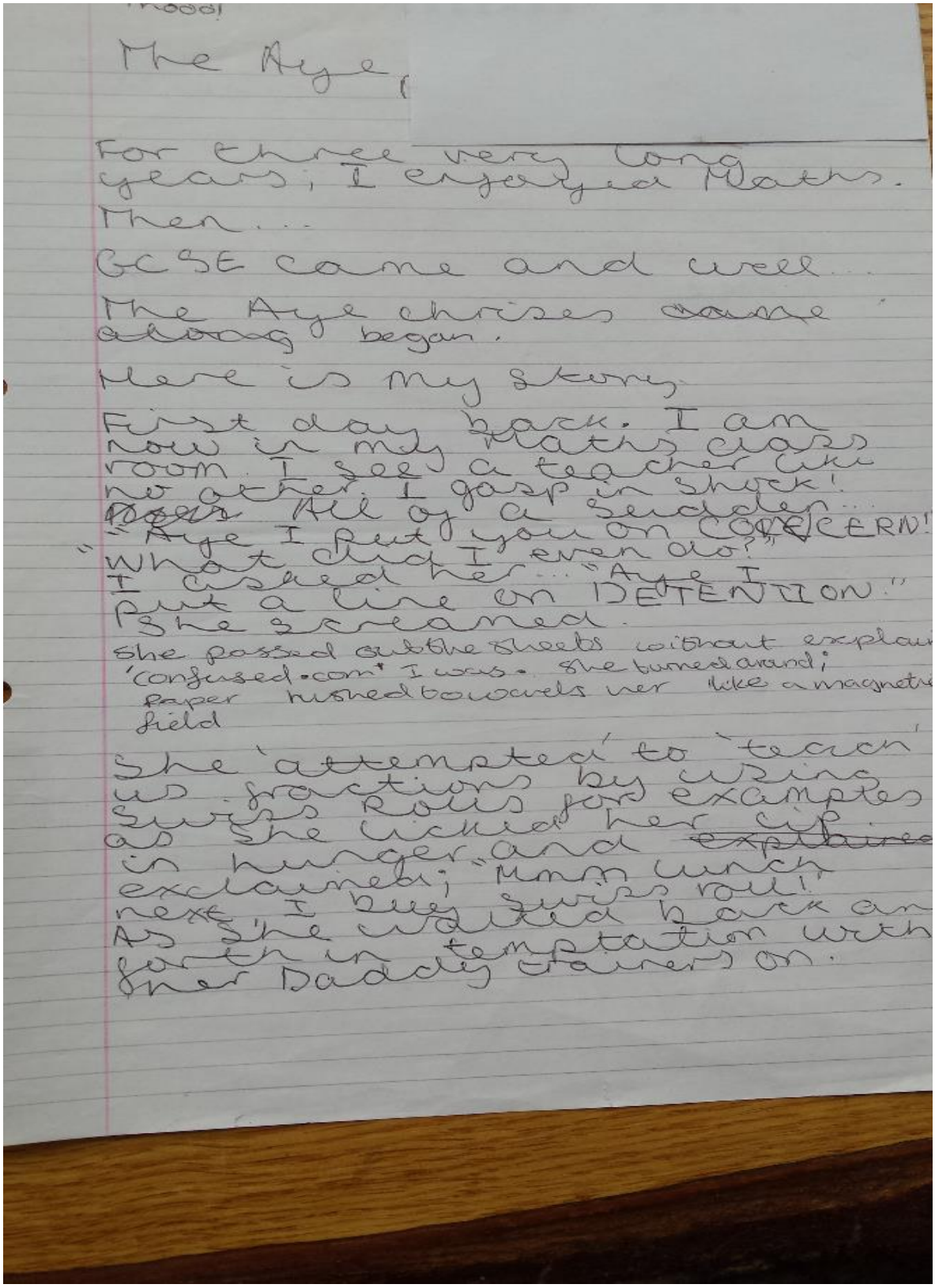
EXAM !
PASS
PASS
FAIL
FAILURE...
REVISE
REVISE
1st TRY
2ND TRY
3rd TRY
100%
KeeP, TRYinG...

Story 6 Seventeen



Story 7 Sweets

Story 8 The Aye



The Aye,

For three very long years, I enjoyed Maths. Then...

GCSE came and well...

The Aye chrises cause ~~abuse~~ began.

Here is my story.

First day back. I am now in my Maths class room. I see a teacher like no other. I gasp in shock! All of a sudden... "Aye I put you on CONCERN!" What did I even do? I ~~asked~~ her... "Aye I put a line on DETENTION." She screamed.

She passed out the sheets without explan 'confused.com' I was. She turned around; paper rushed towards her like a magnetic field

She attempted to teach us fractions by using Swiss Rolls for examples as she licked her lip in hunger and ~~explained~~ exclaimed; "Mmm lunch next I buy Swiss roll!" As she walked back and forth in temptation with her Daddy trainers on.

Appendix D Preliminary work with SI Questions

Compilation of questions

1. What do the students stories represent mathematics as?

Mathematics is about thinking properly, good preparation and not just about getting grades.

Prison, sanctions, lacking in freedom, no go areas, and baffling

Number, shape, and mathematical operations. The numbers have relationships, one group is sequential and the other group is the first three even positive numbers.

An indicator of place in class, this student has a last place rosette

Right and wrong answers.

Algebra, answering questions, passing tests, learning by rote.

The student shows lots of questions in her head and some frustration.

Something that is told to you, something that is difficult and requires a lot of work.

Times tables features, also a jumble of signs and numbers, including decimals and fractions.

Mathematics is depicted as an object; it is male and the enemy.

It is something that is told to you.

They indicate that writing out pages of the mathematics books is **not** what mathematics should be.

Mathematics is exams, discomfort, sanctions. Mathematics can mean staying quiet and perhaps, isolated.

A very unpleasant experience during a particular period of time.

Passing exams and doing what you are told

2. What seems to be important in the world of mathematics?

It is important to try hard and be prepared. To be successful you need to be the winner.

Place order (last place rosette drawn)

Solving problems indicated by a diagram with missing entries.

Relationships: with numbers. The multiply and divide sign seem to have a relationship in this picture.

The student has drawn money bags which seem to indicate some financial benefit.

To be able to answer questions in class, understanding algebra, revising well, to keep trying until you are successful. Pleasing the teacher by trying. Doing well in tests.

Winning is important, strength appears to be important. Status as in qualification seems to be the ultimate result.

To learn mathematics there has to be some control, and/or respect.

The teacher has to be 'normal' and take charge of the class.

You cannot learn from lots of teachers.

A particular teacher features in this story.

There is a pre and post GCSE period, one is enjoyable and the other is not.

3. What is the story saying about past experiences with mathematics/mathematic lessons/learning mathematics /assessment?

Prince charming only wanting someone who was good at mathematics might indicate that you need to be good at maths to be successful in what you want. The poor girl is terrible at maths and she finds it hard. To be successful you must try hard, ability is not enough.

Grades are not the most important measure of ability.

There is a suggestion in the story that maths lessons are linked with detention, a feeling of being trapped and that they are not always happy events. The lessons pose problems; the

student finds the work baffling and does not want to be there. The picture of a Swiss role gives me the message that she is talking about last year's experiences, (the class often recount a funny story about the teacher and a Swiss role). She has some diagrams surrounding the numbers and I think these are linked with memories of particular lessons.
Parent pressure makes her feel small and like a failure,
There are some unhappy periods, being shouted at by parents, being labelled a failure. There is a classroom scene where the student is very unhappy because she does not know the answer to a question posed by the teacher, but very happy when she does.
They are unpleasant and scary; they seem to be dominated by an authoritarian approach to learning – being made to learn under pressure. They show a family interaction to learning mathematics as scary and hated.
The rebellion in the mathematics lesson led to students bullying teachers, students misbehaving even if they were normally well behaved, teachers not teaching them and being horrible to them. Doing whatever they wanted and not learning any mathematics.
The girl looks trapped and confined in the mathematics exams and there is a sudden cheeky change when the exam finishes. Mathematics is stressful.
Past experiences were enjoyable.
Current experiences are confusing and unfair

4. How does the student appear to feel about mathematics?

The story indicates that it is the route to being successful in life.
This student seems to be unhappy with mathematics and finds the subject difficult. There are angry faces depicted, sad eyes, and startled/confused expressions. She seems to place herself in the position of last. She is not at ease in this situation.
I get the sense that this student likes maths, finds some of it hard and really wants to do well in the subject.
Fearful of mathematics, scared of having to recite tables-tables.
Mathematics is the enemy!
There is no mathematics happening in this story. But it clearly points out that bad teachers can spoil the mathematics.
This student does not like mathematics at present.

5. What emotions are displayed in this story?

There is a feeling of happiness, and a sense of justice that things will work out right in the end.
Unhappy, frustrated and trapped.
As indicated by the drawings - possibly humiliation, anxiety, sadness and anger. Also awe and confusion.
This story has an air of loneliness and misery associated with it.
The story suggests confusion, being unhappy, frustration, and a sense of feeling very small and bullied. There is happiness when she passes a test or knows the answer to a question. There is also an element of determination.
A sense of feeling small in front of the authoritarian adult.
Fear, sadness, anger and aggression.
Hostility and rage.
At the end (when successful) satisfaction and happiness.

Remorse- guilt (of students), anger of adults. Excitement

The girl looks miserable, stressed, nervous, lack of confidence lack of self-esteem lack of self-worth. There is a sense of relief, happiness and freedom for a short time. Lack of respect for her body a sort of self-destruct with the sweets.

There seems to be confusion, anger, but also a sense of fear and shock and perhaps guilt at her own behaviour towards this teacher. Surprise at the events that unfold.

6. Who are the people in the story?

Cinderella (the subject), prince charming (the object of desire), and Snow White (a peer).

There is one girl in this story

The girl, her parents and her teacher.

The girl and a male adult who could be her father. Mathematics also appears as a male person.

This story contains details of 5 particular supply teachers and one permanent classroom teacher, and some students.

There is only the girl in this story.

The teacher, the student and there are other students in the class.

7. What do the stories say about classroom practices (discourse) i.e. is there evidence of classroom practices?

There is an element of assessment in the story, the girls will be asked a question and this will determine their future. There is a right and wrong answer. Value is given to working hard and being well prepared.

The use of sanctions is an over-riding theme. The student does not know the answers, and ranking seems to feature highly.

Taking tests and getting the results back.

Sitting at a desk on own, working on paper or a book, putting up hand to answer questions.

Teacher standing at front of class teaching from the board, asking the student's questions indicate a formal experience.

No, there is no evidence of the classroom, the story is particularly personal.

Making students write out sections of text to keep classroom control.

Sitting at desk on own, very formal set up- could be because it is an exam but this student would not have sat a formal exam. Sign asking for quiet, no eating, and no drinking.

The practice of using detention as a threat to try to make students conform. Students not being able to defend their position if they perceive a wrong decision has been made.

Worksheets given out to students in mathematics classes. Sheets passed out with no explanations. Teacher walking up and down the room (pacing), student misbehaviour when back is turned. Using concrete examples to explain a mathematical principle. Work must be completed quietly.

8. What is the story saying about the teacher or teachers?

This is unclear, but there is a trend showing authority as entrapment, confinement and sanctions.

This is not clear.

They talk about their looks/ image, their ability as teachers and their management of the class.

The teacher image is key to how the students perceive the subject.

9.What is the role of the adults in the stories?

They are possibly all adult in this story. They have social roles and class roles

There are no adults explicitly portrayed in this story.

The parents are portrayed as dominant, the teacher? The teacher has a formal role in delivering the lesson and sharing knowledge with the student.

The father is drawn as very tall, upright aggressive because he appears to be shouting, drilling mathematics into a small subserviently posed child.

The girl as an adult is happy, successful and strong

The adults are portrayed as powerless, incompetent, unfair and foolish.

There are no adults depicted, but there are authoritarian signs – no eating! Shh! Etc- shown.

The adult is the teacher, she licks her lips in hunger thinking about food, she walks back and forward with her daddy trainers on, She screams 'detention' at them. The adult is out of control in this story.

10.Who are the dominant players in the stories? What is the story saying about power?

The most powerful person in the story, prince charming is male and educated. If you are educated you will only want somebody who is educated. The adults are reasonable. There is a sense of class division with the poor girl needing to work harder but doing better in the end.

This story is showing the student as a prisoner, this is significantly mixed with mathematics as she has a mathematics sign with no entry lines across it. Mathematics seems to hold the power to trap this students and so appears to be the dominant player.

The parents are very dominant and the girl seems to shrink in their presence. The teacher seems small and insignificant in the picture but the girl is upset if she cannot give the teacher the answer.

The adult has power, the girl does not.

The dominant players are the pupils, they recount the highlights of interactions with various teachers and their lack of control and power. This indicates that the pupils felt they were the controlling force and the story sounds a little like guerrilla warfare on the part of the students. There is certainly remorse and reflection in the fact that perhaps they should have tried to work with their original mathematics teacher as what they got next was not an improvement. Again an indication that they were in control even if they did not realise that at the time

The girl seems to have the power to rebel, she is eating a lolly in the exam/class situation

A teacher and the students: The teacher is dominant by her anti social class room management, lack of teaching skills but with the power to enforce punishments. The student perceives a clear unreasonableness in the teacher as a person and as a teacher.

The student indicates the power of the class by their use of misbehaviour when the teachers back is turned (paper rushed towards her like a magnetic field).

11. How is language used in the story?

The language is very light hearted and follows the line of a fairy tale.

The story is a medley of symbols that portray emotions and feelings. As such there is no story being told just a reflection of the student's position in this world.

The story is a cartoon with a set of mathematical experiences shown in the drawings. There are only 5 words: Exam, Failure, Revise and keep trying.

The story has a language thread throughout, it is used to tell the tale and the pictures are used to display the emotion.

The language is used to make an impact (perhaps to shock). It is written in pupil speak which makes it somewhat private between the students. The language is 'colourful' and designed to highlight flaws as teachers and people od those highlighted.
The pictures are powerful in the way they show how the girl is feeling, her anxiety with the situation and her behaviour when dealing with things. The author is drawing attention to the effect the stress of doing mathematics has on her social life and how she treats herself. There are a minimal amount of words used mainly as labels of signs, packaging and to clarify what the student is carrying.
This is a story where language is used to make the 'tale' amusing, interesting and descriptive.

12. Where does identity fit with this story?

The student identifies with justice, if you deserve success you will get success. This student knows that effort and work will help her be successful in mathematics and the story is very positive.
This student does not identify with being able to do mathematics, she is trapped in the mathematic lessons and says she is baffled about what is going on. The mathematical identity is strongly negative and a mathematical world would not be her choice she indicates an element of force in making her do school mathematics.
This student wants to do well in mathematics, it appears to be important. She is happy when she can answer a question and unhappy when she can't. Being able to answer questions in class is important, so she wants her peers to see she is good at maths.
It looks like the key to not being labelled a failure by her parents is good maths results.
This student has a strong identity with needing to be successful in mathematics, she wants to be successful in this subject and will fight to get what she wants. She is determined to be successful and knows she will win in the end.
She identifies mathematics and the adult as male and unpleasant , both she is fearful of, and as such, are not part of her ideal world. She has to 'kick ass' to make her world the way she would like it. This might apply to how she feels about the parent and what she would like to do.
These students are shaping their identity as someone who controls others even though they know it is wrong to treat another person in this way. Some are exploring a 'bad girl' image and where that positions them in the friendship groups.
The students do not want to model themselves on this teacher so the role of significant other in learning and shaping of identity is left to the strongest personality in the class.
The girl seems to be two different people: the one who is miserable in the mathematics context, and the other who binges on sweets as part of her freedom from the previous oppression of tests, and then is still not happy because she is ill, fat and spotty.
The student does not want to identify with this teacher or what she represents. That may transfer to the learning of mathematics as no learning takes place in this story.

13. Is there a social aspect involved in this story?

There are appears to be a class distinction in this story. Poor girl, less well educated – has to try harder than the other girl but it pays off in the end. Relationship is important.
The mathematical world of the student consists of parents who seem to nag, chastise and drill. A teacher in a formal classroom setting.

No, this is a lonely personal story of a battle. Although her father is portrayed it does not signify family situation, any sense of nurture or togetherness.
Yes, the students looked forward to the lessons because they enjoyed bullying the teacher, the class was out of control and behaving in ways that were out of character for some usually well behaved students. This was providing entertainment.
On a more subtle note, the teachers are portrayed as unnatural, alien, not normal people and the normality of a teacher seems to matter..
This girl is shown as very lonely and isolated both in school and at home.
There is a strong sense of companionship amongst the students.

14. What is the 'baggage'?

There seems to be some preconceived ideas about poor and education.
Happiness is related to relationships and success in mathematics.
Terrible at mathematics means you won't get your prince.
Mathematics has a great deal of authority and the most desired person is good at it and desires people who are also good at it.
There is a work ethos brought to the setting.
There is an understanding that grades are not set in stone and can be lost without effort.
Problem solving is mathematics and has to be worked at.
The student brings negative emotions, feelings of entrapment, randomness of mathematics (symbols, signs, numbers, shapes, all with connectivity within themselves but not with each other). A sense of failure is strong. The student appears to have accepted defeat and their place in the order of things. They know that they can be naughty I am not sure where choice fits in i.e. choice to behave or take part. The student equates mathematics/ mathematics lessons with a prison cell.
There are expectations that mathematics is formal and difficult. That you work on your own. It is important to be able to answer questions in class. I feel there is an expectation that mathematics should be drilled in to you. But it is clear that the student knows that she has responsibility to work at things and improve her assessment results.
There are emotions embedded in this story, a sense of feeling very small and bullied. Frustration and determination linked with being successful at mathematics, but happiness when she passes or knows the answer.
There is an air of confidence and I get the feeling this student knows she is good at maths but is frustrated at some of the practices associated with mathematics.
Emotions such as sadness, fear and anger are brought into play with mathematics. There is a sense that this is a battle ground and with that the tensions that surround people at war. The facial expressions indicate a lack of comfort with her position in and with mathematics.
Never take teachers for granted.
The consequences can be worse than the original event.
The world of mathematics teachers contains some 'misfit'people.
Lack of respect for supply teachers
Even good girls can behave badly.
A teacher can spoil your mathematics.
Fun can be disrupting the lesson.
A sense of how powerful students can be

There appears to be very negative feelings associated with mathematics which in the story is linked with assessment.
This girl seems to have personal problems, she is concerned about her image, and is not happy with her self image. She seems unable to be who she wants to be.
She seems to feel isolated
Her behaviour appears impulsive
That the GCSE period can bring a ‘crisis’.
Teachers can control whether you enjoy mathematics.
The image of this teacher is very poor!
Classroom sanctions can be very unfair and you have no way to represent your side of things.
There are situations when you may behave very badly.
If there is unfair behaviour on the part of the teacher then students may/will replicate that behaviour.

Appendix E Comments from Colleagues

Picture 1

Always found maths hard, fearful upsetting. All jumbled together and nothing made sense. ‘From a young age’ shows never had good experiences of mathematics. Maths is like rain pouring down from the clouds.

Her father at home not being supportive and making student recite times tables over and over again. Being scared of going home because of the maths that would be waiting. Now hating maths.

The war between the student and teacher happened. The student attacked maths and found that in spite of the teacher she was beginning to understand and was no longer afraid. This meant her understanding grew and she felt much happier.

Very successful in the future, achieving a maths PHD from Cambridge. Shows that all obstacles can be overcome and the boundaries no longer exist.

Views of mathematics are changing, no longer feels scared and upset. Now feels it is possible to achieve and to reach great highs in the future with a subject that at first was not a happy experience.

Picture 2

Child sitting in school looking very scared and confused. Hands not on the desk, so not doing any work just sitting there watching the clock until the lesson ends.

Leaving school looks upset, drops maths books on the floor doesn’t turn round or even look at them. Does not care about them. Or maybe they have been thrown away as they are too upsetting.

Terrified of exams, not even able to eat as so frightened. Once again hands are by her side, she has no confidence and is not able to answer the questions in the test.

Eats in the exam and seems much happier? Teacher gives them a sweet?

Eating lots of rubbish makes a difference, makes her happier and she feels that she can cope. Bag full of sweets etc to keep her going. (This picture was hard to see, could not make out what was written on the bag or the piece of paper sticking out of it) Okay it is a Sainsbury's bag with lots of sweets in. And a packet of walkers crisps sticking out.

Indicates comfort eating and the girl on the picture is much larger in size than the one shown at the beginning. No longer looks so happy but still all of the sweets etc are still present in her life.

Being sick in the toilet, not clear if she is making herself sick. Maybe she is just sick of what she is doing and what she has become. All the worry and anxiety has made her ill. She can no longer think clearly and feels sweets and chocolate will make everything all right.

Girl depicted is now very large and her skin is a mess. Due to all the rubbish she has been eating. She no longer looks happy, comfort eating is no longer working and does not make everything alright.

Moral of the story, she realises that this is not a healthy way to behave and acknowledges that it is the stress that brings it on. It is good to see that she knows that she will do the best that she can and that this is okay.

Picture 3

Sees maths as number work.

Times tables. Heart seems happy and able to speak. Circle looks angry. Triangle is very small and quiet, looks scared. Hexagon looks confused. They were making a comic strip about maths.

Teacher Miss rectangle was not happy she seems to be shouting. Triangle got 50% in test, Circle got 75%, Hexagon got 32% and Heart got 32% Teacher not happy with hearts results. All of the shapes look happy with their results.

Students not happy with their teachers remarks, and see the only way forward is to get a tutor. Do not ask their teacher for additional help. Interesting that two of them get tutored together. Heart and hexagon who got the lowest marks feel they need a tutor. The picture seems to show that the teacher was not supporting them, she is drawn on one side of the paper and the students with the tutor on the other. Also indicated that heart has always found maths difficult. Hexagon looks scared but heart looks very happy with the extra help. Teacher still seems to be shouting but the square tutor is smiling and looks happy.

They studied hard until they became clever! It shows that if you study you feel more confident in your ability.

Heart has a smile on her face and seems to be giving a thumbs up. Hexagon also seems very happy. They obviously feel much happier with their maths and it seems the tutor not the teacher has made this possible.

In the final picture Heart still looks happy but hexagon is neither happy or sad.

Overall - Seems to indicate that the classroom teacher has great influence over the students. Did not seem willing to help the students only to criticise and tell them there results were not good enough.

Picture 4

Shows a very confused student with lots of questions going round in their head.

Needs to sit an exam on algebra. Can't answer the questions so frustrated that she breaks her pencil in half. Lots of confusion everything on the paper just seems a jumble.

Other students in the class happy with their results, 100% and 85% being passes. Both papers have large ticks on them. She on the other hand gets 12% and fails. Paper has a large cross on it. She is very upset, there seems to be a big black cloud over her, she is crying, also lightening present this could be her anger at not being able to get a good score.

And so it carries on. She cannot shake the black mood, things do not seem to improve. Other students in the class understand what the teacher is saying but she does not. She does not put her hand up, either to answer a question or to ask for help. Interesting to see the child who understands is smiling and has a sun over her head.

Looks like three children are being shouted at by their parents. The youngest is crying but none of them seem to be happy. The student feels like an absolute failure. She is lying on her bed crying.

She tries really hard. She revises, then revises, then revises some more. Each time she tries the test her grades improve, 40%, 70% and lastly 100%. The smile on the face grows as the grade improve.

The moral of the story is keep trying no matter how hard you are finding things.

This story board is very specific to algebra maybe this is a topic this student found hard to

understand, but with practice and perseverance they got better and better

Appendix F Year 10 Sentences/Chunks of Data

I couldn't tell the time.

Maths at my first school never had an effect.

I was very sure the life of mathematics was not for me.

My head puzzled with the alphabet in the maths.

Algebra and square root of what. Stem and leaf is science?

Bullies, work and weight on my mind.

Messing around and throwing things.

Left the room in a state.

Looked at teacher in spite because he could not cope.

Did not like maths.

Found maths hard.

Did well in all subjects apart from maths.

Teachers shouting at her!

In year 10 she got a teacher who was a fairy and she helped Evelyn !

Evelyn got good test results.

Learnt very little in year 7 and year8 attributes this to teacher problems.

Things improved in year 9, started to find maths easier.

Teacher explained very well.

But failed her maths exam.

Did not like maths.

Did well in all subjects apart from maths.

In year 10 she got a teacher who was a fairy and she helped Evelyn!

Found maths hard.

Evelyn got good test results.

Learnt very little in year 7 and year8 attributes this to teacher problems.

Things improved in year 9, started to find maths easier.

Teacher explained very well.

But failed her maths exam

Very upset that she had failed in year 9.

… was happy with her test results in year 10.

She made everyone proud of her.

Royal family, vast amount of land, and a kingdom.

Sibling who is smart but sad not to have a brother or sister.
Secondary school I messed around and missed out vital information.
No teacher.
Learnt nothing in year 7.
In year 8 the teacher was distracting.
Failed several exams in these years.
Not reaching my target.
I achieved my target grade.
Year 10 learnt more and finding exam work and HWk easy.
In primary school me and maths got along.
Year 9 started to get my head down.

Learned more about maths.

I went down to the level I had in primary school.

I achieved a lot of praise.
In primary school I understood it and got good grades.
I worked hard.
I need help remembering.
Forgetting in a test makes me angry
In year 10 my knowledge is continuously growing with maths.
I've loved maths since I was born.
I am not good at it.
I hate getting questions wrong.
I love times tables.
Confident in class.
Forget most of the method when doing a test.
I want to work in a big company high class bank.
In primary school we used a lot of times tables.
Teacher really good at explaining using a few words. He taught us in a fun way.
The best time was in primary school.
I have a job as a banker.
Year 10 a lovely teacher that helped me get my grades up.
I wasn't really good at maths because

Year 7 no teacher
Year 8 a good teacher that shouts and bangs the tables.
Year 9 a lovely teacher.

Year 9 sentences/chunks of data

Maths is boring and sometimes I feel like snoring.
Teachers are rude and for some reason they give you attitude.
In my past maths was good. I enjoyed it, I still do I just hate the fact that it is boring and usually many sums are complicated.

Year 8 was the worst, my maths teacher was rude and I don't know why but it seems they pick on the quiet ones.

But on the other hand maths is quite essential to life because it involves a lot of things which is quite important.

I usually enjoy maths, but through my previous experience especially in year 8, my confidence in maths wasn't so good.

In primary I preferred it more than I do now. PS maths isn't really boring.

Maths is a treat in real life happening

Maths is needed but it is also stress

But it's a great subject a really good subject

Maths is a gift of life you know

You're born with eight fingers and two thumbs and ten toes don't you know

Maths will help you in life to pay your bills and fly a kite with co-ordinates

At the end Maths is a game you win some you lose some, well you have to play

When I was in primary I used to do maths, I was OK in maths but I wasn't bad

It was boring, very boring

For your education, that maths

For your future, that's maths

For your career that's maths

For your job that's maths

For your life that's maths

Now I'm in secondary I still hate maths

I know I need it, I need maths

Maths helps U with everything.

It's good to learn maths!

In reception: What is maths? Hate Math! Don't get it. Never listen and never revise!! **Get me out of here!**

Year 1: I find it so boring!! Seriously how could these people like maths. Didn't know how to add, subtract etc. Find it so confusing. Get me out of here!!

Year 2: Yay! Finally know how to do subtract, adding etc. So proud!! But still I hate maths. I think it's not important. So never listen in maths lesson. **Get me out of here!**

Year 3: Ahhhh! We have SAT's. Never knew therefore did not do revision. But I thought that Sat's wasn't important. ….. Who cares !!! **Get me out of here!**

Year 4: As I go along in maths leson I find that maths is important. Also I was regretting that I did not revise for maths. **Getting there!**

Year 5: I find maths is interesting!! Yay!! But I don't really love maths. But sometimes I find maths is confusing. **Getting there!**

Year 6: Again we have Sat's. I hate it but I am not scared coz I listen in maths and try to participate. **Getting there !**

Overall I think maths and English is the important subject.

I never realised that maths was important!! Getting there. Horray

I need to read the question properly.

I think as you get older you may realise how important maths is in life and how important it is to learn it because in year 9 it is nearly near your GCSE's and you know you need to focus a lot and try the best you can.

In maths sometimes I make silly mistakes like for example there was this test I got back and marked and there were some silly mistakes that I know how to do but I just make silly.

Fact: Math, Science and English are the most important subjects.

Before any big test I get a bit nervous and hope to do well. I really want good grades.

Maths is very useful in life …. For example %, because in shops they might give a % out of something you need to find out.

To me maths is a very tricky subject.

When I was younger I knew I had a problem with Maths because everything was difficult and as I started to get older everything became harder and harder.

I don't find everything in maths hard because some things are easier in maths, for example, times tables are easy.

But I do like things about maths like division, angles, times tables, adding and subtracting.

My opinion of maths is that I do enjoy it most of the time.

I enjoy maths because, I know it sounds stupid, but I don't know why I do. I just do!

The small % of time I don't enjoy it is when I understand the work but when it comes down to writing the work I make stupid mistakes.

I do better classwork than when I have a test. I think it is because in a test I get nervous and I just make mistakes.

When I was younger I actually despised maths! But as I have gotten older I have grown to enjoy it more and more.

When I was younger I was more a drama, English, music, geography girl. But now I enjoy math, dance, English and drama person!

I go to army cadets and for that you need to be a bit quick in maths, because in map reading you have to add all the angles together etc.

I want to be the best in maths so I can get a really good GCSE level.

I guess when I was younger I didn't like maths because of my teachers.

But in …… I have improved, I hope! I think that is because some teachers are good at helping you, well all the teachers I have had.

Over all my say on maths is- Maths is like a coconut, it is hard to get into but once you have it's all good.

The first lesson was about adding and subtracting. ……..thought it mustn't be that hard but Amy just remembered that she was in a higher maths class.

When the maths sheet arrived …… could see numbers and plus and subtract signs. She was confused about the work.

She looks on her right side and sees that …….. is showing off saying that she is the smartest and the prettiest. Amy was embarrassed of course; she did not know how to do anything.

Ms …….. was looking around and she sees that ……is stuck; she came up to …… and helped her.

…….. was giggling at…….

…….. finally understood what to do but the class was almost done. …….. worked as hard as she could and finished as soon as the bell rang. …….. was glad because she didn't get put in catch up but …….. did and she wanted revenge.

At the playground, …….. was playing catch the ball with ……..and then …….. stumped into the game. ……..threw the ball to …….. but Sally caught it and threw it at ……..'s stomach. …….. was stunned. ……..was about to hit b…….. ut the bell went and she ran off.

Two weeks later they were learning about fractions. …….. started to like maths and became smarter, she had the second highest level in the class.

…….. thought that fractions were the most difficult but she was the smartest at it. She helped other people because they were too confused to know, she told them it was pretty simple.

At the maths test …….. was very confident and got a high level, …….. got the same level.

Miss …….. was a really good teacher and she was a real friend sometimes …….. likes to call her Maria, (it's her real name), and she doesn't mind.

…….. had the lowest level but she did not care about it and said she is the baddest girl in the class.

…….. was glad she had maths class because her best friend was there and her favourite teacher was teaching her and she says that maths is the easiest subject (except for Art, Art is the best).

……..couldn't mess with …….. anymore because if she did she would have to leave the school.

Appendix G: Adult Story

This story was written by a student that took part in the pilot stage of the research, and at this time she had contributed to a rather angry story about having many mathematics teachers and how inadequate they were. She also acted out a short drama for the class but as this was spontaneous it was not recorded as data. After that pilot stage this student worked hard at her mathematics and had a good relationship with her mathematics teacher, who stayed as her teacher until she had finished her GCSE mathematics. She achieved the grade she needed for the next step of her educational journey. This story was written when the student was sixteen years old, had finished her lessons and was on study leave for her GCSE exams. I will let the story speak for itself because I feel it highlights the need students have for individualism and creativity.

Adult story: My experiences of Maths

When I was a child, maths was known to me as a subject with never ending riddles that I would never be good at. Everyone would excel in maths, while I would be reading a book or reciting a poem. I then remember being continuously forced to understand the subject by numerous teachers. All I really wanted was to do something expressive and creative.

In year 7, maths was more of a drag. The room was gloomy and the work began to get harder, it felt as though someone was thrown into the deep end of a swimming pool before they were taught how to swim. I was trying my best to settle into a new school but it seemed as though I was making more of an effort to settle into a specific subject.

Year 8 was full of laughter, we had about 20+ supply teachers. Our first ‘teacher’ Ms E was too concerned with her ‘praise, concern and detention’ graph. We then discovered ‘100 things to do in a lesson’ and began to do all activities on the list such as ‘sing opera as loudly as you can’, ‘switch the computer off while the teacher is teaching’ and our favourite, ‘throw paper around the classroom’. Our second ‘teacher’ made us copy all the answers off the board and then allowed us to do whatever we wish. The final ‘teacher’ that is memorable is miss A, she had a mental breakdown in front of us and snapped my friend’s pen during the process. We felt as though we were witnessing something in a mental ward.

Although we had a blast with Ms E and every day seemed like a party, hence my non existing ‘10 brothers and sisters’ that I needed to collect after school and made up questions from my ‘text book at home’ that literally could never have an answer. I did not realise how behind I was in this subject until year 9.

Year 9 started off quite steady as I assumed I understood everything we were doing. However, nothing was as it seemed.

In the recent years, I have accepted that I will never enjoy maths but I am treating it as something that I need to look good on paper. Friends that achieve high B’s and low A’s are always complaining about their grades whilst I’m achieving C’s and D’s, parents that say I am not working hard enough to understand and teachers that tell me I am doing well when I don’t believe it myself.

The day that I finish maths forever will be like some ones version of paradise. I will be completely able to concentrate on Art, Drama and English Lit, the subjects that allows me to fully enjoy and express myself whilst being creative.

No matter what happens my feelings and thoughts about mathematics will never change. You may think that my thoughts have evolved by the way I was taught, my mind frame should be a lot more positive or I shouldn’t listen to what others say as I know everyone is good at something. I find no joy in either maths or science, simply because they are subjects that do not allow me to do the things that I love.

Furthermore, the only ‘happy’ moments in maths are the times when I understand what I’m doing. I do not enjoy the process of understanding it and I absolutely hate the idea of sitting a linear exam, although I know it is easier to pass, the very thought of doing maths in exam conditions for something as crazy as two hours is my definition of living hell.

The best experiences I have had whilst being taught maths has got to be in year 8. The constant ‘Aye too loud’ being shouted out whilst the squeaky white board marker furiously writes on the board, which sounds as though an innocent mouse is being slaughtered.

To help me pass my exam, the answer booklet to the exam paper would help dearly as I would score 100% in the exam and my teacher would look good.

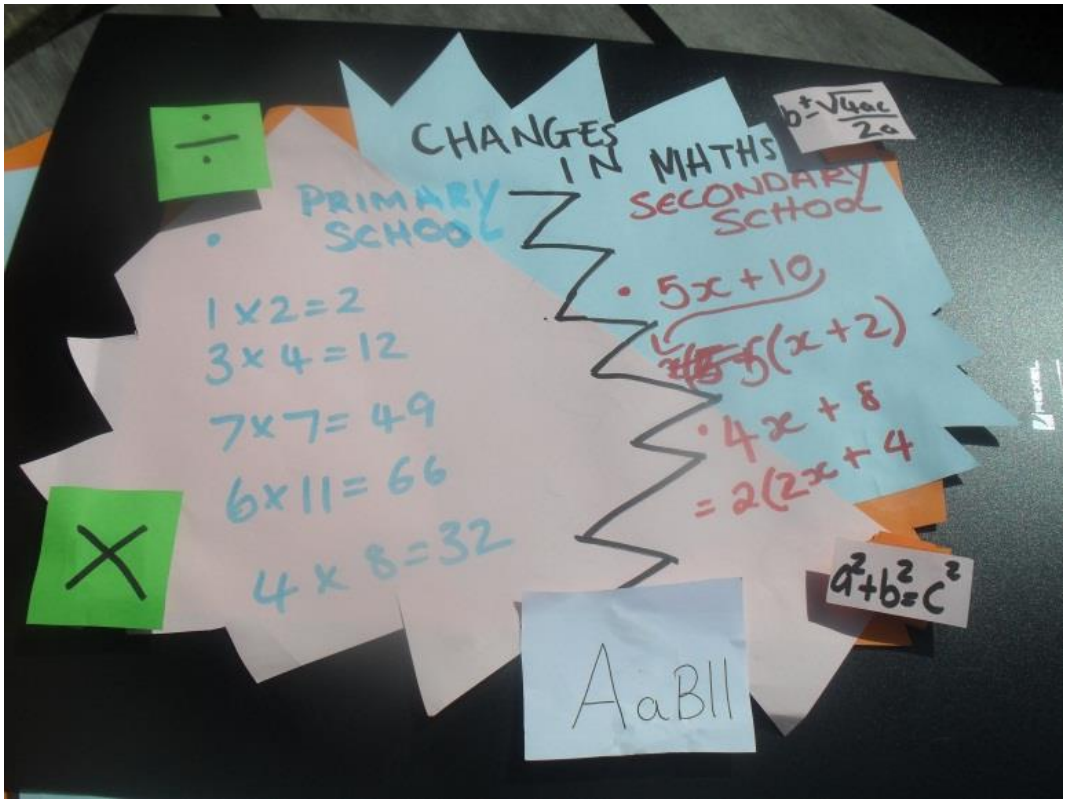
After I have officially finished maths I do not ever want to see another number in my life unless it’s for useful things such as clothes, and a high value of numbers in my account or he number of awards I may get as an aspiring actor and the number of shots they may take on a future photoshoot or scenes they may film or even the number of rehearsals I may have for a theatre production.

Maths contains questions, equations and factorisations without simplifications, the ignition and contradictions, common sense and normal sense.

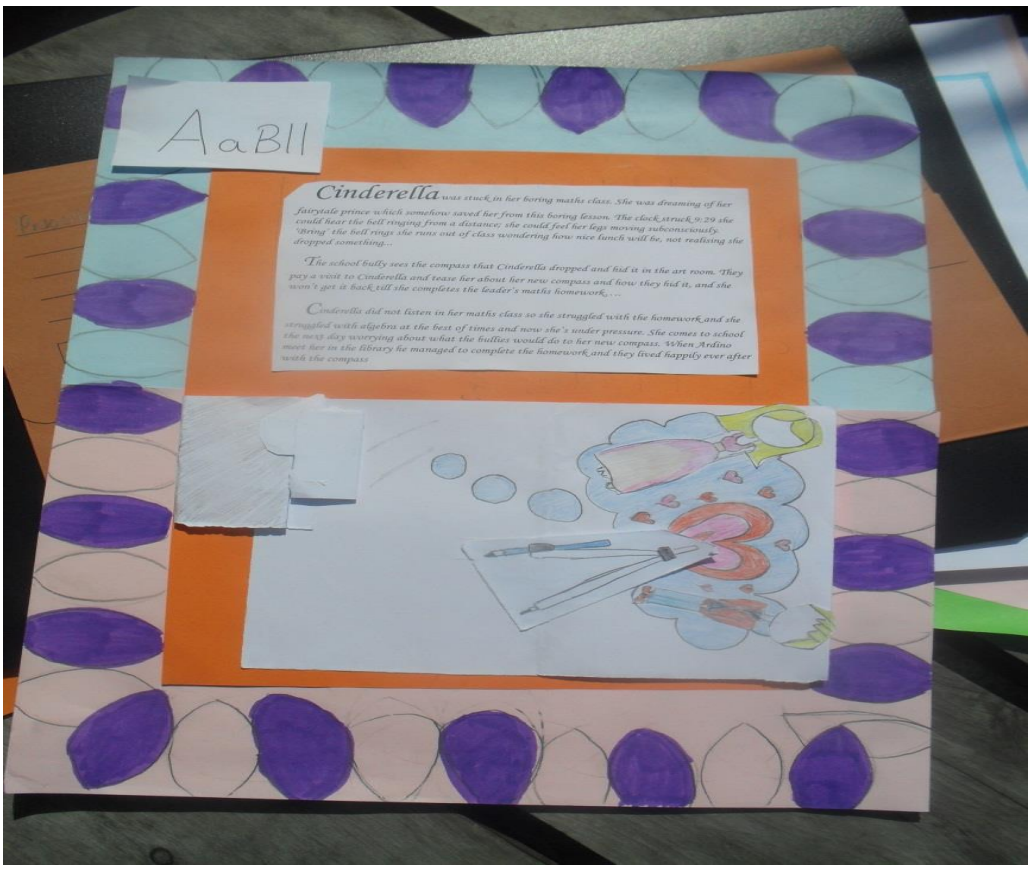
The only time, when the creative mind is locked and lost inside

Appendix H Phase 2 Stories
(Note: All teacher and student names are fictitious)

Changes in Maths



Cinderella



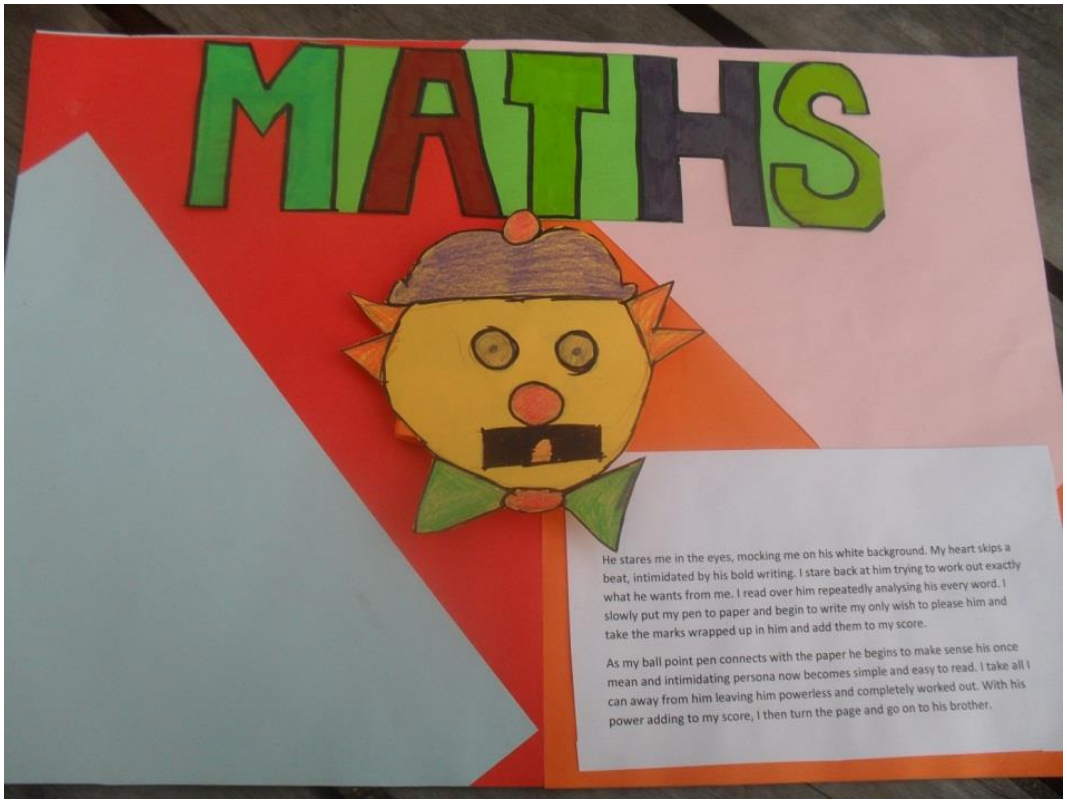
Cinderella was stuck in her boring maths class. She was dreaming of her fairy tale prince which somehow saved her from this boring maths lesson. The clock struck 9.29 she could hear the bell ringing from a distance; she could feel her legs moving subconsciously. 'Bring' the bell rings she runs out of class wondering how nice lunch will be, not realising she dropped something……..

The school bully sees the compass that Cinderella dropped and hid it in the art room. They pay a visit to Cinderella and tease her about her new compass and how they hid it, and she won't get it back until she completes the leader's homework…..

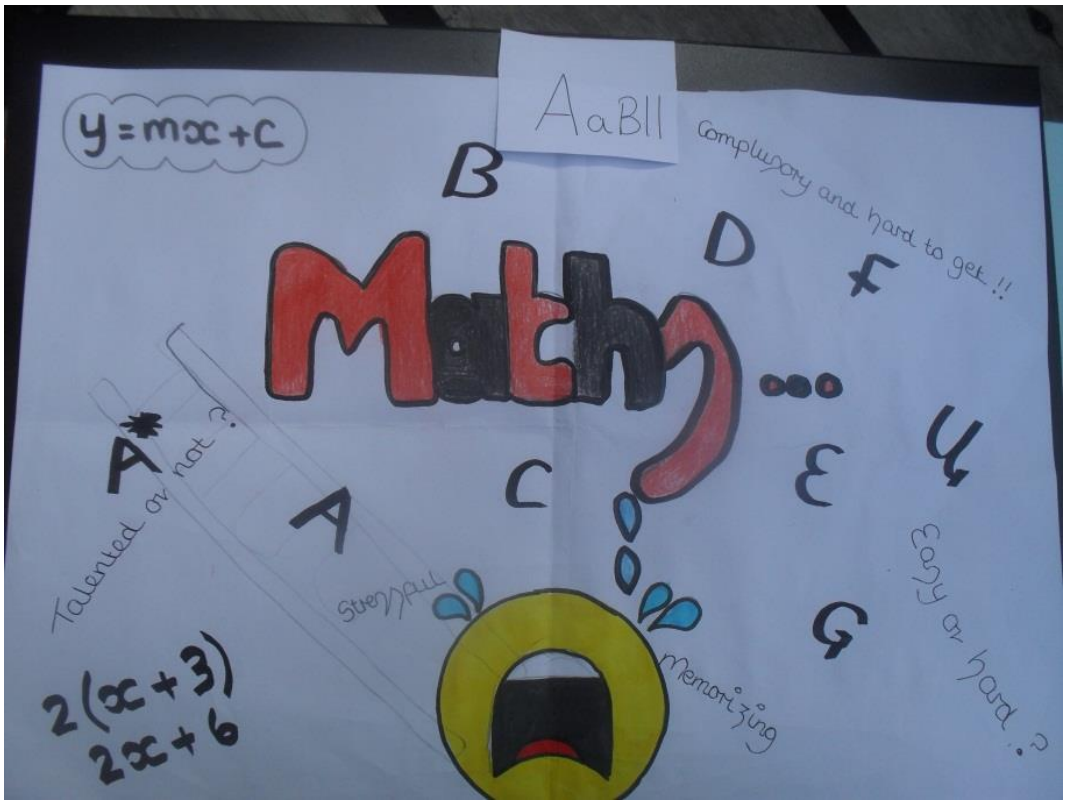
Cinderella did not listen in her maths class so she struggled with the homework, and she struggled with algebra at the best of times and now she is under pressure. She comes to school the next day worrying about what the bullies will do to her new compass. When Ardino met her in the library he managed to complete the homework and they lived happily ever after with the compass.

Clown

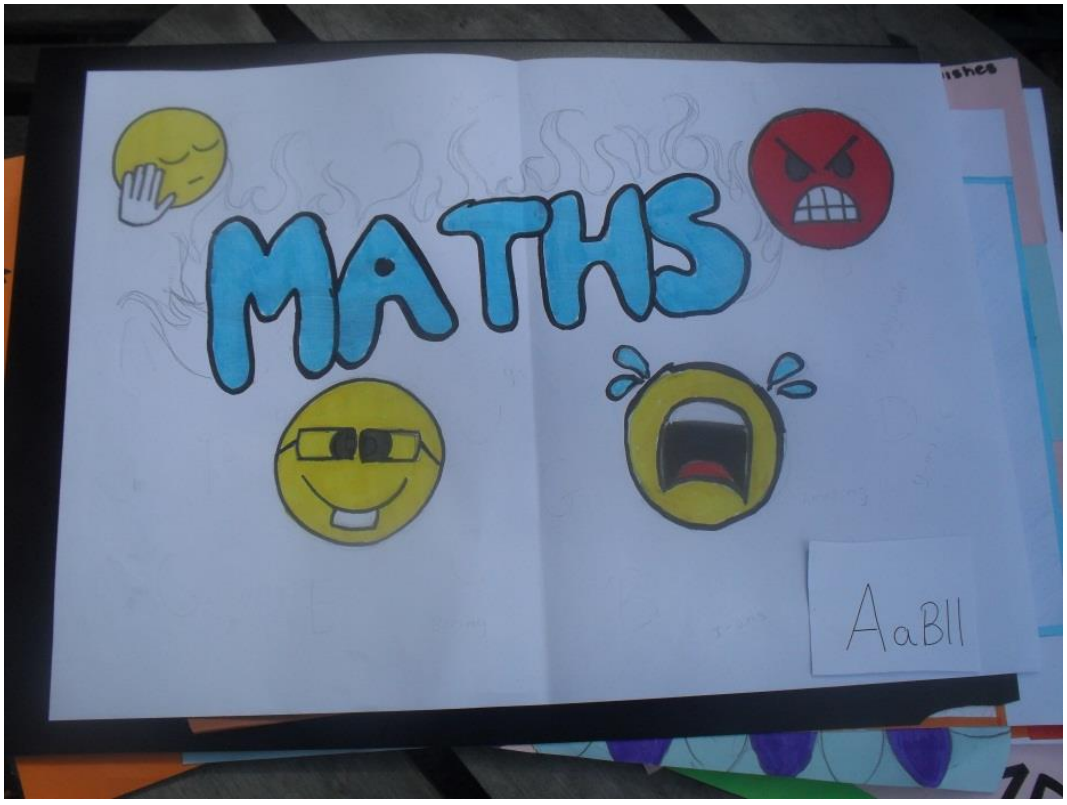
(Text on page 183)



Crying



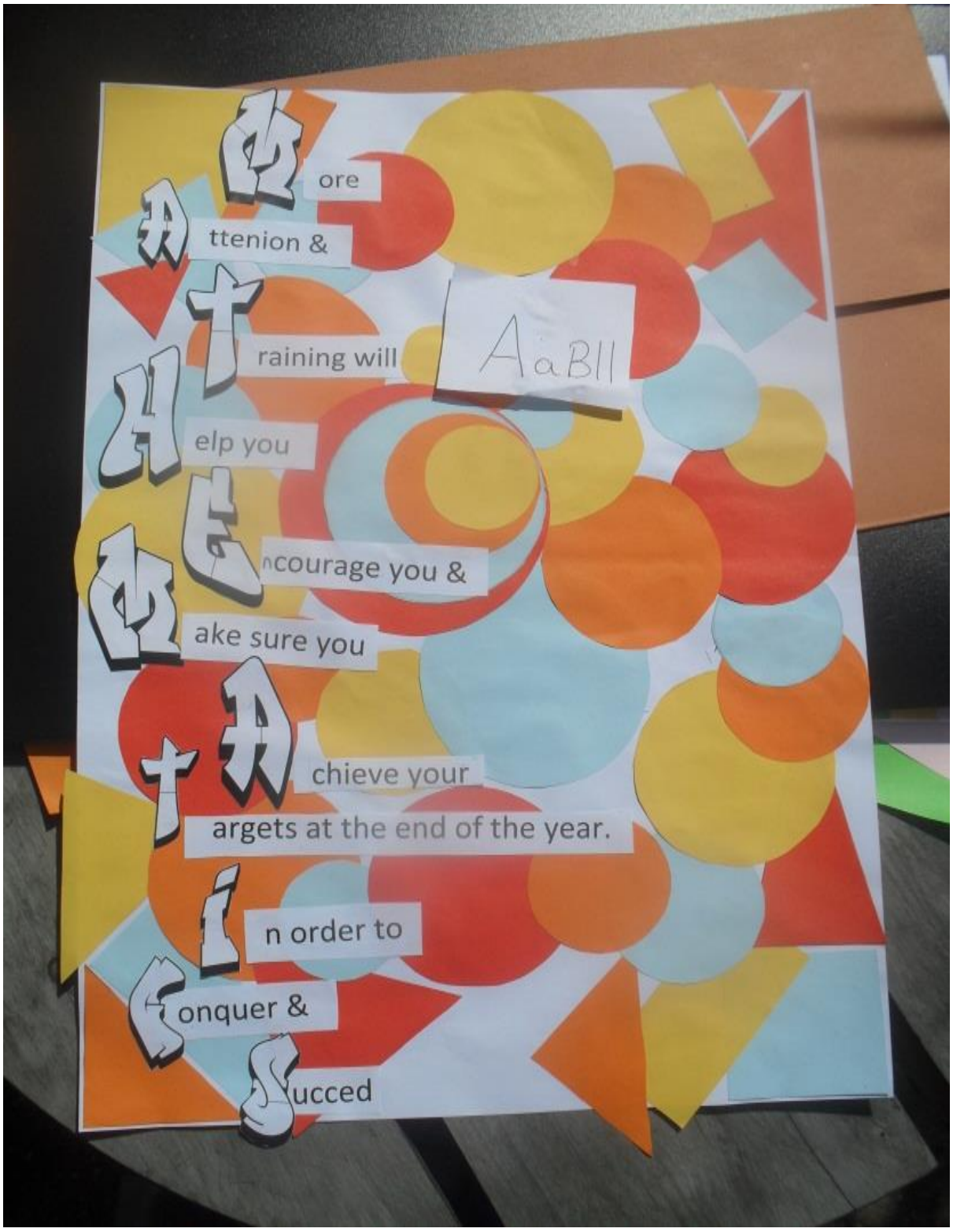
Faces



Formulas

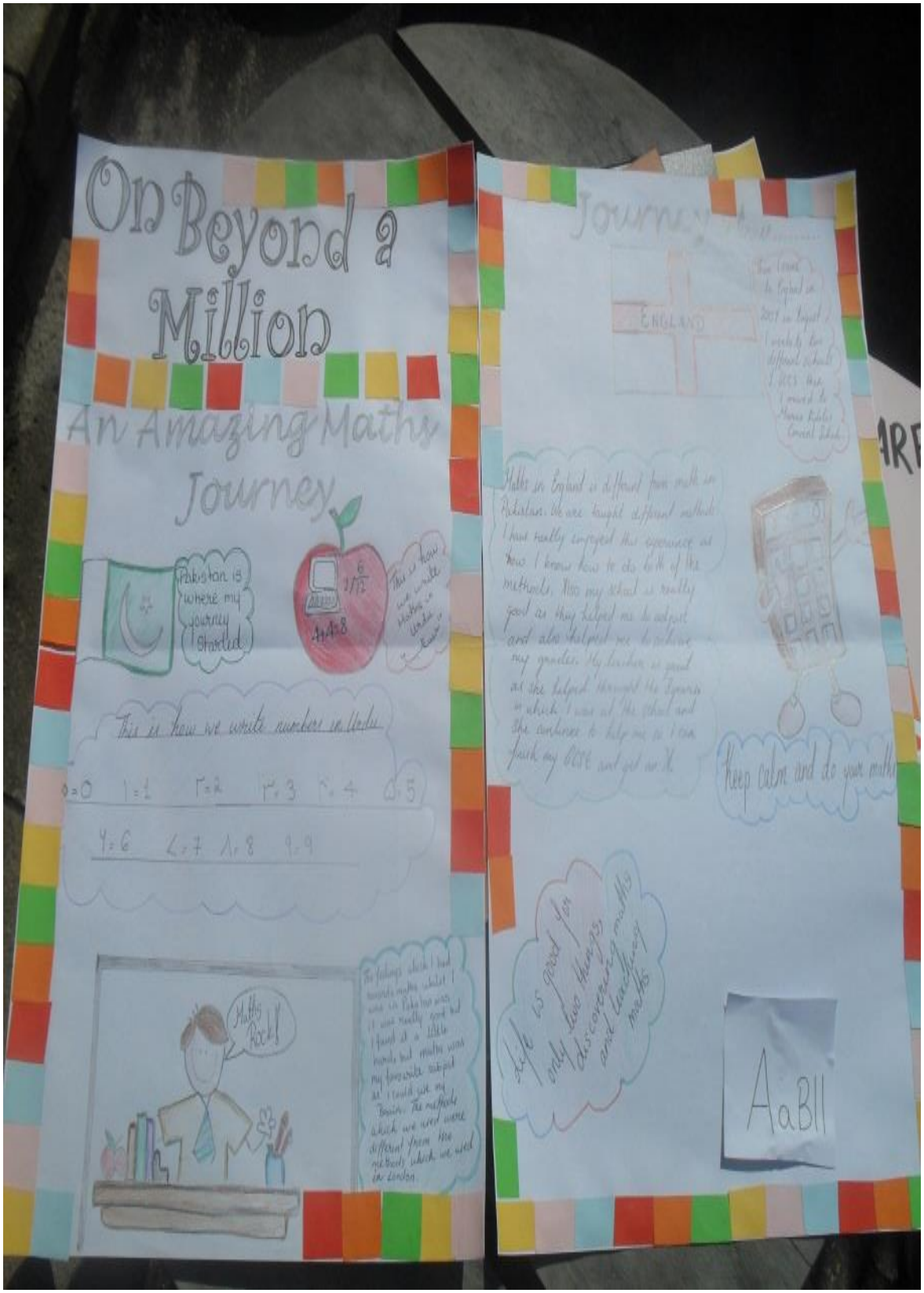
I Love…

Mathematics



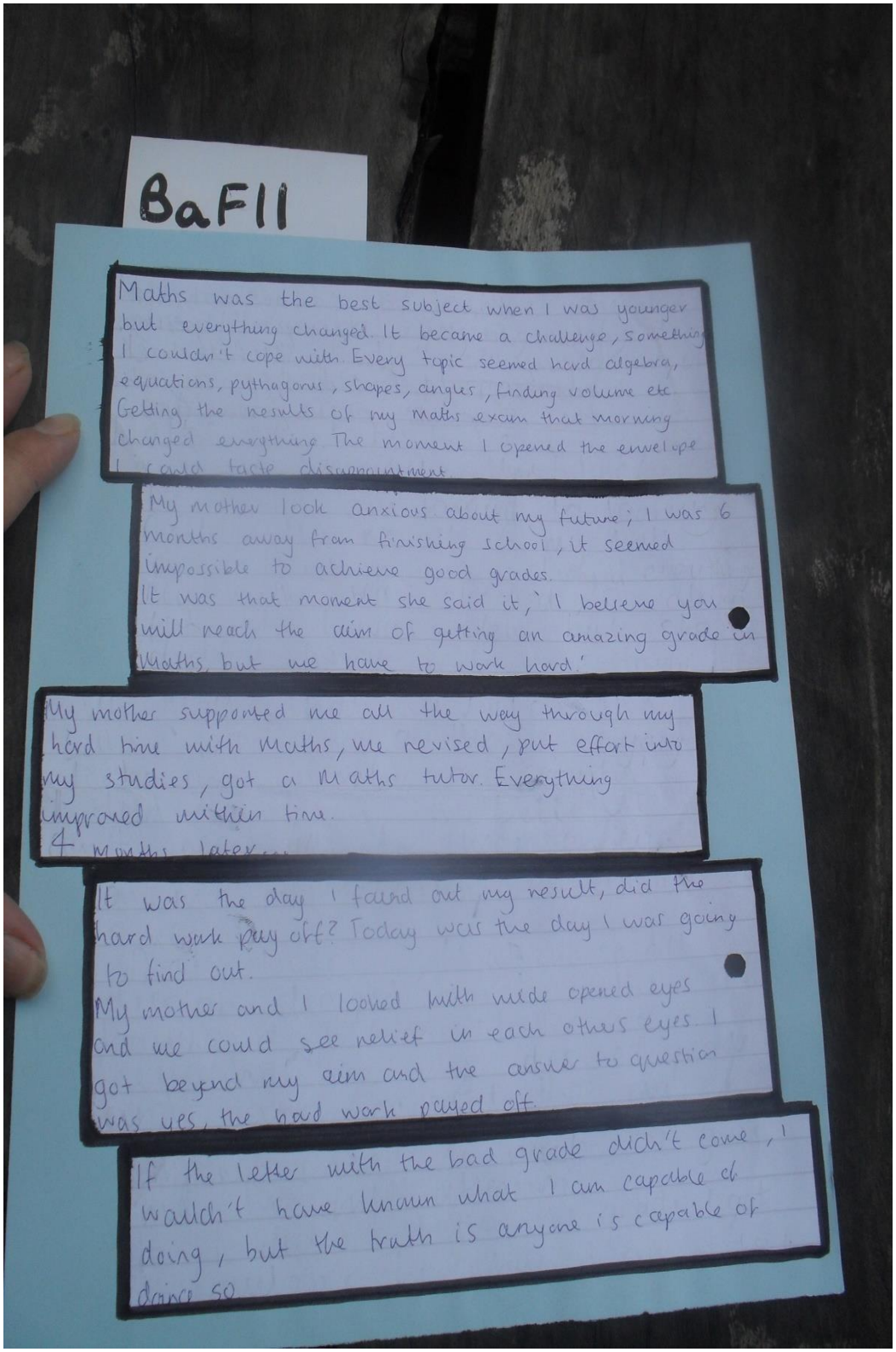
On Beyond a Million

(Text on page 202)

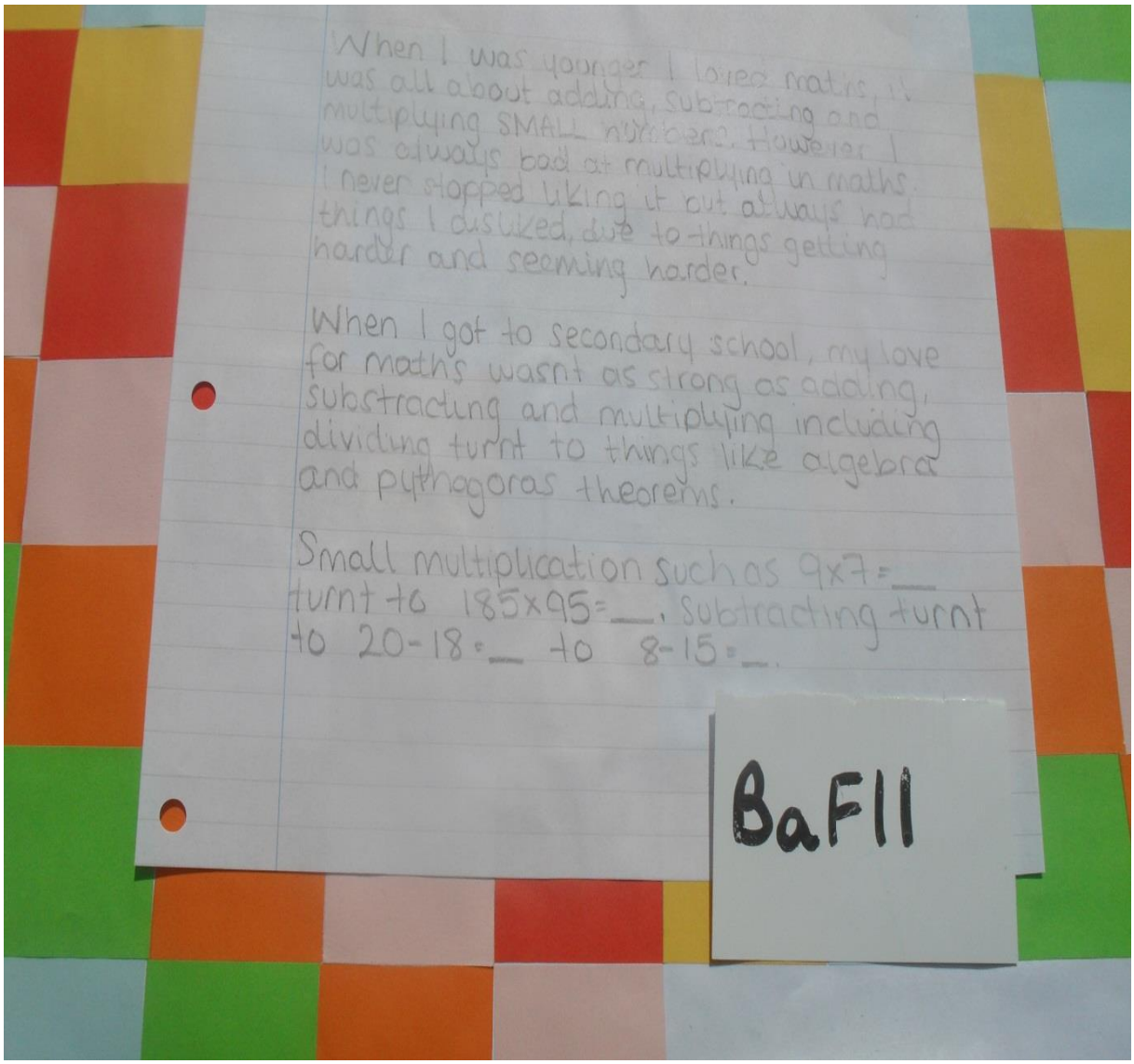


The Letter with the Bad Grade

(text on page 211)



Coloured Squares



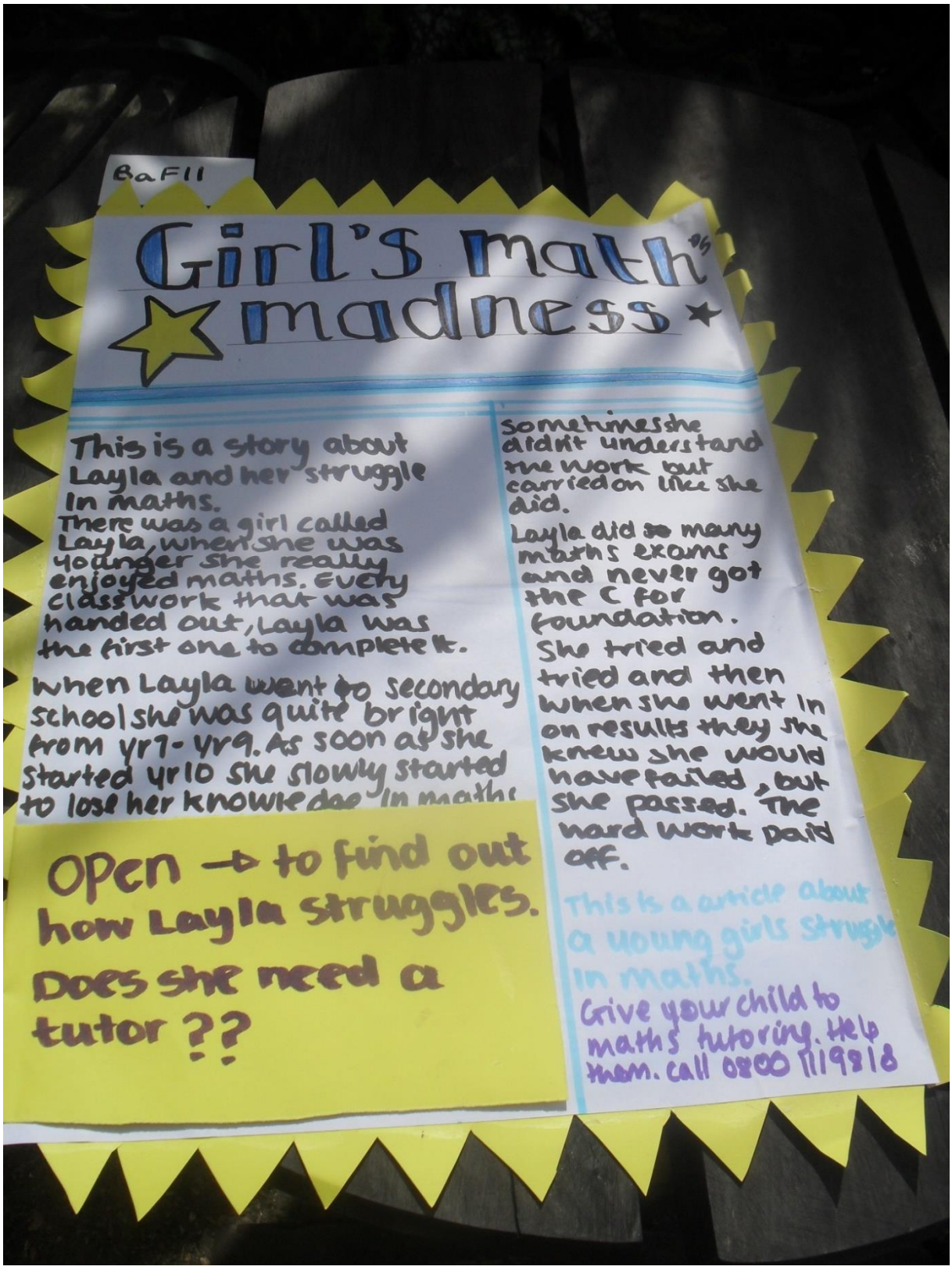
When I was younger I loved maths, it was all about adding, subtracting and multiplying SMALL numbers. However, I was always bad at multiplying in maths. I never stopped liking it but always had things I disliked due to things getting harder and seeming harder.

When I got to secondary school, my love for maths wasn't as strong as adding and subtracting and multiplying and dividing turned into things like algebra and Pythagoras theorem.

Small multiplication such as 9x7 = …. turned into 185 x 95 = ….

Subtracting turned from 20 – 18= …. To 8 – 15= …..

Layla

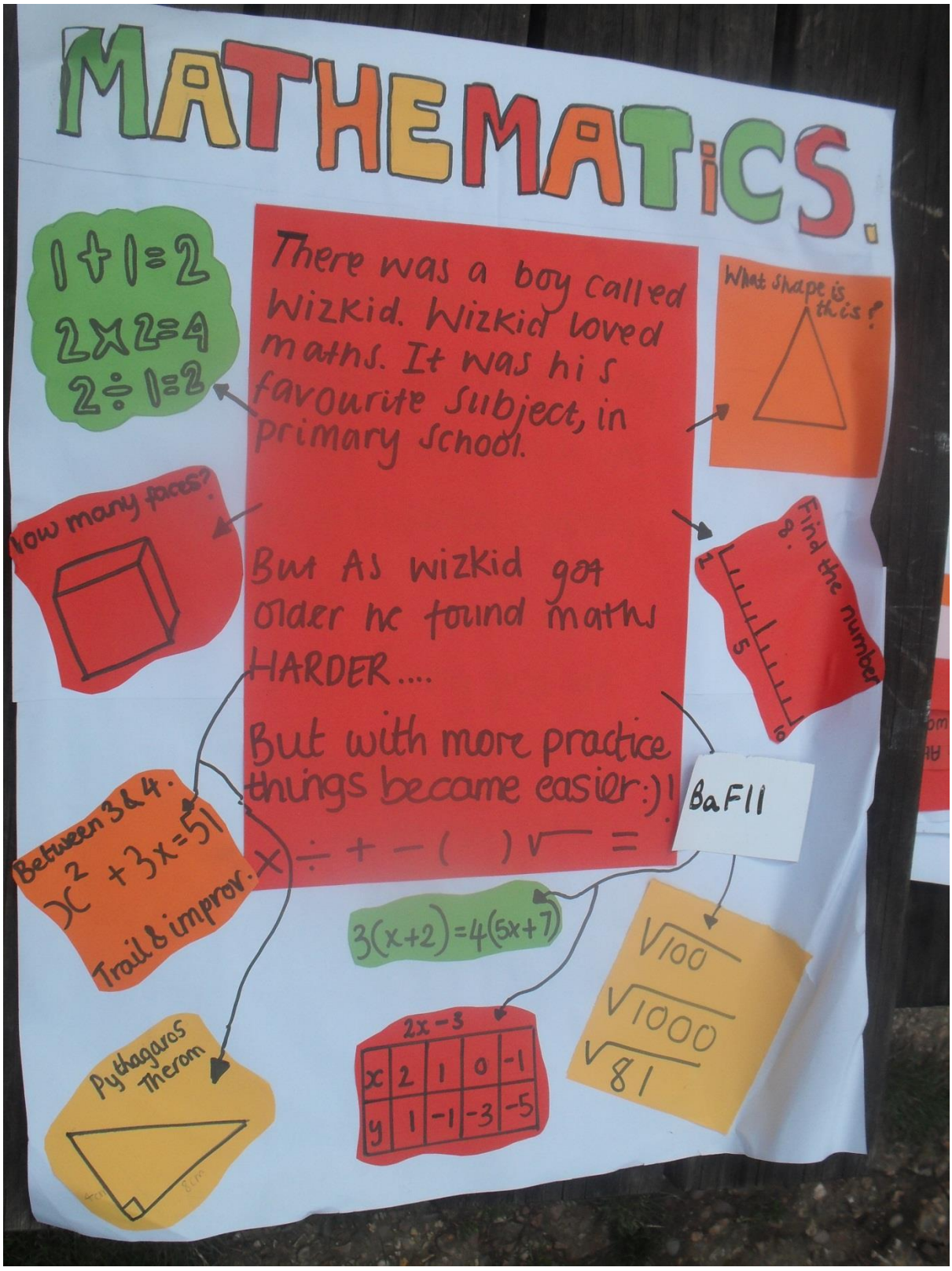

BaF11
Girl's math's madness
This is a story about Layla and her struggle in maths.
There was a girl called Layla, when she was younger she really enjoyed maths. Every classwork that was handed out, Layla was the first one to complete it.
when Layla went to secondary school she was quite bright from yr7- yr9. As soon as she started yr10 she slowly started to lose her knowledge in maths
sometimes she didn't understand the work but carried on like she did.
Layla did so many maths exams and never got the C for foundation.
She tried and tried and then when she went in on results they she knew she would have failed, but she passed. The hard work paid off.
This is a article about a young girls struggle in maths.
Give your child to maths tutoring. Help them. call 0800 1119818
Open → to find out how Layla struggles.
Does she need a tutor ??

The Boy who Found Confidence in Maths

Inside the flaps.

The boy hated maths. He didn't know his times tables nor did he know how to add fractions. Maths for the boy was a pain, especially maths lessons. He boy always worried about having the wrong answers. On the day of the maths exam the boy would sit there in the hall and stress about everything maths related. Until one day his teacher told him about a website called 'Manga High'. The teacher said it would prove to be very useful and a fun way of learning maths. The next time the boy went to his maths lesson he was confident and began to enjoy mathematics.

Whizkid


MATHEMATICS.
1+1=2
2×2=4
2÷1=2
There was a boy called Wizkid. Wizkid loved maths. It was his favourite subject, in primary school.
But As wizkid got older he found maths HARDER....
But with more practice things became easier:)!
÷ + − ( ) √ =
What shape is this?
How many faces?
Find the number
Between 3 & 4.
x² + 3x = 51
Trail & improv.
BaFll
3(x+2)=4(5x+7)
2x − 3
x 2 1 0 -1
y 1 -1 -3 -5
√100
√1000
√81
Pythagoras Theorm