The Construction of Girls' Motivational Orientations through their Social Engagement in School Mathematics

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Abstract

This paper represents the voices of six Botswana girls in a case study that investigated social influences on their motivation in mathematics. Interviews were conducted and observations made to explore the girls' experiences to shed some light on where their motivations were most influenced. The girls' perceived motivational orientations and subsequent performance in mathematics as reflected in their case scenarios were used as a way of explaining their social implications. Their social experiential narratives were analysed for meaning with a focus on understanding them from an African context in contrast with Western cultural research perspectives. The study emanated from the fact that Botswana women are not vividly present at the post-secondary level in mathematics, science and technology. A compulsory mathematics at senior secondary school level, most young women opt out of mathematics and technology related programmes. The girls' social experiential narratives were collected and analysed for meaning with a view to understand their implications in learning mathematics in the context of Botswana. The study adopted the Marxist social theory as its theoretical framework and used the concepts of contradiction, ideology, discourse and *habitus* as operational tools for the girls' socialised orientation towards mathematic. It emerged that social environment, namely: the family (*socioeconomic status, educational beliefs, attitudes, availability of books*); the school system (schooling, teachers, textbooks, mathematics curriculum, and assessment) and peer groups (friends, classmates) were the key sources of influence. The interpretations of the girls' narratives gave rise to the conclusions drawn and the recommendations made concerning social influences on their motivational orientations in learning mathematics.

Keywords: Gender Differentials in Mathematics, Botswana Mathematics Education, Social Structures, Girls' Motivational Orientations, Women and Girls' Voices.

INTRODUCTION AND BACKGROUND TO THE STUDY

The system of education in Botswana prior to tertiary level is in three phases, namely Primary School, Junior Secondary and Senior Secondary school. Girls are generally not doing well in mathematics particularly at the senior secondary school level where it matters most. There are no significant gender differences in mathematical performance at the primary and junior secondary school level. However, examinations at senior secondary school level continue to show girls performing poorly as compared to boys. This has prompted the author to investigate if social structure in Botswana influences the way girls learn mathematics.

Social conditions profoundly influence behaviour and modify the development and action of persons who grow up within a given society. Social determinants influence the formation of traits of personality, attitudes, interests,

motor behaviour and goals (Young (1961: p. 22). As in most African societies where traces of patriarchal attitudes still prevail, there seems to be limited cultural flexibility in the means by which individuals are permitted to achieve a code of behaviour in Botswana.

The Africa Economic Commission (AEC, 1999: p. 3) reported that in African cultures:

> Many harmful practices are perpetuated due to ignorance, or although recognised as harmful, because ostracisation from one's group has very severe consequences, those who dare to break with tradition are often cruelly teased, humiliated, mocked and looked down upon.

In many cases, good conduct is imposed both by the family and the community in the form of a rigid social code. Personal differences in attempting to restyle social demands to suit personal drives are discouraged by the school, the church, the family and by peer culture.

The research was informed by the structural Marxist social theory, while Foucault's approach to discourse offered a way of analysing the girls' social conditioning through mathematics, despite his criticism of Marxism. Foucault introduced *discursive practices* and *discursive formations* to the analysis of particular institutions and their ways of establishing orders of truth, or what is acceptable as 'reality' in a given society. The general use of discourse is to designate the forms of representation, codes, conversations and habits of language that produce specific fields of culturally and historically located meaning. For this paper, discourse forms can be written or spoken; they include conversations, interviews, speeches, narratives and so on. The characteristics of a discourse derive from the participants' social relations, including their purpose for engaging in the discourse.

Patterns of social discourses were analysed from the girls' experiential narratives in an effort to establish meaning. Gates (2000: p. 127) argued that these patterns of social discourses are:

> [ ] not constructed purely by individuals, but constructed through engagement in the social field and social world, outcomes of one's dispositions and socialisation, mediated by social engagement.

In this sense, the ideological positions that individuals take are derived in part through engaging in such discourses. For this paper, discourse was a key tool in the analysis of the social influences on the girls' motivation in mathematics. While challenging the influences of Marx and Freud, Foucault postulated that everyday practices enabled people to define their identities and systematise knowledge. From this postmodernist view, the underlayers of suppressed and unconscious knowledge form the codes and assumptions of order, the structures of exclusion that legitimise the epistemes, by which societies achieve identities (Appignanesi, 1995: p. 83).

The construction of girls' motivation in mathematics is partly due to changes in their social personalities resulting from their learning personalities. Each girl's learning personality is the combination of natural talent, personal interest, current opportunity, social environment, character, motivation and how the brain processes information. The girls' experiences as captured through interviews and observations were presented in story form.

The Study Goals

The study aimed at contextualising the 'gender in mathematics' debate by using the voices of six Botswana girls in their social engagement in school mathematics. It did this through investigating the social influences on the girls' motivation in mathematics with a view to explaining their poor performance in the national examinations which has been consistent over the years. The theoretical and conceptual frameworks used in the investigation are discussed below.

THE THEORETICAL AND CONCEPTUAL FRAMEWORK FOR THE STUDY

The study stems from the author's argument that learners are constructed to view mathematics the way they do by the operations of social structures. For this reason, the study adopted the structuralist Marxist social theory as the basis for investigating the social construction of six Botswana girls in mathematics education. The concepts of contradiction, ideology, discourse and *habitus* were then used to aid the operationalisation of this theoretical framework.

Social structure refers to those features of a social entity (a society or group within a society) that have certain permanence over time, are interrelated, and determine or condition to a large extent both the functioning of the entity as a whole and the activities of its individual members. Accordingly, human beings form social relations that are not

arbitrary or coincidental, but exhibit some regularity and persistence. Social life is not amorphous but is differentiated into groups, positions, and institutions that are interdependent, or functionally interrelated. These characteristics of human groupings, although constituted by the social activities of individuals, are not a direct corollary of the wishes and intentions of these individuals; instead, individual choices are shaped and circumscribed by the social environment.

In relation to the girls in this study, the social structure puts constraints on what they should know about mathematics, and suggests to them how they should feel about, perceive and react to it. The notion of social structure implies that the girls are not completely free and autonomous in choosing their activities, but rather they are constrained by the social world they live in and the social relations they form within it.

Case study scenarios were constructed encapsulating the social and cultural structuring of the girls in the learning process. This construction reflected the author's understanding and interpretation of the six girls' experiences, which directed their inclination to (or away from) mathematics. The analyses of the interviews revealed how the girls acquired certain ideas about mathematics, its nature and learnability through interacting in social and cultural environments. Such ideas became internalised and incorporated into their belief systems ultimately appearing as their own, with an impact on how each of them experienced mathematics in classroom dynamics.

The study regarded the internalisation of ideas and subsequent beliefs about mathematics as ideological formations. Accordingly, the girls were being interpellated to view the world of mathematics in a particular way by the environmental factors around them. Each girl developed an ideological level opinion resulting from the correlation of opinions on a wide range of issues relating to her knowledge of mathematics. Ideology in this sense refers to a highly organised structure of opinions representing a general way of thinking about the world or society. It is from this understanding that the construction of the girls' stories proceeded and each story represented a social critique. The stories constructed thus, were forms of discourses derived from or created through certain material and ideological structures, bearing their meaning inherently

The structuralist route that the study took assumed a constant structuring of mathematics learners as subjects, having certain social values and expectations. Learners are tied to the whole structure of 'school culture', that is, to the values socially and culturally attached to this culture. The structuring occurred within the socio-cultural context of Botswana; hence the girls expressed personality characteristics within that context.

The Marxist social theory adopted to understand the social influences on girls' motivational orientations, poses questions on why the concepts of contradictions, ideology, discourse and *habitus* were used for its operationalisation. Within social structures, contradictions between the socially dominant and subordinate groups usually lead to tensions and conflicts. Individuals within societies face conflicts because of problems related to the distribution of power to control. This relates to unequal distribution of goods, differences in social and economical opportunities, social suppression, tribal struggles and many other areas of power relations. Because tensions and conflicts are discernible, the study endeavoured to find out to what extent the girls' social frameworks indicated the existence of these concepts, how they were resolved and to what extent they were indicative of the girls' motivational orientations.

Habitus and ideology are concerned with the internal way in which the girls were reacting, why the girls are what they are and how this relates to the pattern of Botswana society. What they do not indicate is how these issues get played out. Knowing that the girls acquire *habituses* and that they are subjected to the subtle constraints of ideology does not tell us how this happens. It is through understanding what discourse is all about that one begins to see another dimension that seeks to explain how the other concepts are played out. It was necessary to look at the motivational influences of the six girls through the lens of these concepts because each of them adds its own dimensional flavour to the structuring process.

Habitus is a set of dispositions, reflexes and forms of behaviour people acquire through acting in society (Bourdieu, 1990). There are ways in which it has an affinity with ideology, yet both are complex to define. The beliefs, values and habits acquired through 'cultural conditioning', which is the *habitus*, define ideology. In this sense, the operation of both ideology and *habitus* are geared towards 'naturalising' the actions of individuals within social structures. *Habitus* underlies second nature human characteristics and their infinite possible variations in different historical and cultural settings (Shirley, 1986). Ideology is "a socially defined way of thinking and acting, a set of conventions and assumptions which make meaning possible, the taken for granted world of everyday life" (Sharp, 1980: p. 96).

In order for the girls in this study to participate willingly in activities and institutions such as school, family, church, and peer groups, the activities have to make sense to them in the context of a particular *habitus*. The willing participation means that much of your *habitus* is communicated through how people talk, what they talk about and what they do, which is what discourse is about. Burke (1989) argued that culture and communication mould who we

are, how we think, and how we act. Berlin (1993: p. 103) argued that ideology "addresses and shapes (subjects) through discourses that point to what exists, what is good and what is possible". According to Halliday (1978: p. 100), "ideology gives language a very active role in coding experience and mediating social meanings." It suffices to say that the girls acquired their *habituses*, which formed their personalities, and were constructed by ideological forces in subtle ways through discursive means.

In this way both ideology and *habitus* use discourses as their modus operandi. The major differences between ideology and *habitus* lie in their effects on those they operate. In this study, each girl is equipped with a *habitus* (shaped in formative years by home culture) that bears affinity to a larger referential group/class *habitus*. Their *habituses* are reflected through the forms of conduct most likely to succeed for them in light of their resources and past experiences in learning mathematics. For instance, their tendency to *"work with people"* on which they formed a consensus, derives from the Botswana cultural beliefs which constrain girls towards being nurturant. But this is in conflict with their more ideological *'mathematics is important'* discourse since it turns them away from that discourse. Yet, they cannot escape since they have to be assessed in mathematics as a way of 'filtering' them for socio-political purposes.

In contrast, ideology operates in covert, but hegemonic ways as a system of ideas that aspires both to explain the world and to change it. In the context of this study, ideology constructed the general Botswana public's notions about the importance and usefulness of mathematics. Skovsmose (1994: pp. 5-6) underscores this point by asserting that students study mathematics knowing its importance for their future careers. In this sense, mathematics, albeit in disguised form, is a practical political force that socially constructs learners and affects the way they live and relates to their real conditions of existence. In other words, it has "a material reality and a material force" (Sharp, 1980: p. 95) for the girls.

The girls' discourse patterns arise from their *habituses* as aspects of their enculturation into social groups, and from the constraining power of the ideological forces acting on them. With respect to learning mathematics, the girls' *habituses* are inscribed within the discursive formations which designate the shape of their wider social and political structures, their nature and role as individuals within those structures and the distribution of power in their society (Berlin, 1993). It suffices to say that ideology operates in subtle ways, using discursive strategies to foster the legitimatimisation of dominant ideas. Hence, the girls' *habituses* are acquired under the constraining influences of ideologies, which name the boundaries of what is known or knowable at a given moment in history. The dispositions they acquire are culturally dependent and imbued with ideas and beliefs characteristic of their culture, which means they are ideologically grounded.

Both *habitus* and ideology operate through the power relations between the girls as learners of mathematics and their social milieu. As indicated earlier, the acquiring of dispositions and the controlling power of ideology occur through communication in social fields. These social fields contain competing and contradictory discourses with varying degrees of power to give meaning to and organise social institutions and processes (Weedon, 1987: p. 35). Within the repertoire of discourses in Botswana society, some thoughts are silenced or marginalized if they are not part of the commonsense ideas of society. Culturally, girls in Botswana have certain expectations imposed on them due to their femaleness. This represents the role of discourse as a mode of concealing and perpetuating inequity and regulating behaviour. Some of the things that the girls talked about during the interviews are discourse patterns; they are the things that are believed to be 'true' in their social environment. The sources of the girls' behaviours are patterned by their dispositions, needs or instincts, and by experiences characteristic of their membership to social culture and traditions.

THE STUDY METHODOLOGY

The Study Population

A purposive selection of three girls per school in two secondary schools: one a junior and the other a senior school, was adopted for the study. The mathematics teachers for the two classes were randomly selected by their respective headmasters and in turn, the teachers randomly selected the classes from which the participants came from.

The choice of the sample involving a junior and senior secondary school was an attempt to get views from across the appropriate gender and education spectrum. Gender differentials in mathematics education are widely reported to appear at the beginning of secondary school (Fennema, 1974; Wood, 1976; APU 1985; Hyde *et al.*, 1990). The assumption was that patterns of gender differentials in mathematics begin to emerge as the students enter and proceed with secondary education.

The six participating girls had varying mathematical abilities and each set of three came from the same class in the respective schools. The preference was to get the views from across the mathematical ability range labelled as 'low', 'average' and 'high' to avoid using a homogeneous ability group whose responses might be extremely biased.

Data Collection Procedures

Data was collected during the second school term in the months of July/August before the students began their end of term tests in two phases. The interviews extended to the beginning of the third term in September/October. The timing of the interviews was dictated by the formal schools' timetable, the headmasters' preferences to minimise disruptions, and the avoidance of times when students engaged in local or national academic activities.

The data collection exercise comprised class observations and interviews. The lessons were observed for familiarisation and developing diaries of how the girls responded in class to corroborate or refute claims they made during interviews. Semi-structured interviews were used with probes and follow-ups as the situation demanded. Powney and Watts (1987) describe an interview in terms of a conversation between two or more people with one or more of the participants taking the responsibility for reporting the substance of what is said. A tape recorder was used to record the students' experiences in learning mathematics.

The recorded material was transcribed after every session to help conduct follow up observations and interviews based on the information gathered. The two teachers were also interviewed to corroborate students' claims accordingly.

Data Analysis

The analysis began with the transcription of the taped information. The data was then sorted according to theme areas, categories and subcategories, linking ideas together and comparing the data according to how the girls differed or shared common ideas in their responses in line with the continuous comparison method.

The data was subjected to coding and re-coding as part of the analysis procedure. The continuous comparison test method was used to find patterns in the data from which meaning could be drawn. The emerging patterns were used to develop stories of each girl in an effort to understand how social factors affected their learning of mathematics. The constructed stories formed part of the data analysis from which conclusions on social influences were drawn. According to Holstein and Gubrium (1995: p. 28):

> Storytelling is collaborative, but not simply in the conventional sense that interviews ask questions and respondents provide answers. Rather, the interviewer and respondent interact more dynamically to produce meaningful stories

The analysis endeavoured to unravel the ways in which mathematics 'filtered' students with detrimental consequences for girls' motivation in the subject. At the same time there was constant awareness over the methodological issue of re-conceptualising and recognising learner-generated knowledge in educational research.

THE POWER OF STORY TELLING IN CONTEMPORARY RESEARCH

In investigating the influences on Botswana girls' motivational orientations towards mathematics, the author represented their responses through stories to illustrate how storytelling can contribute in de-silencing the silenced voices of women and girls in African contexts. Foucault's notion of *subjugated knowledge* was used to illustrate the epistemological position in this paper. When referring to knowledge that has been *buried* in the mainstream, Foucault (1980: p. 81) advises that:

> [...] subjugated knowledges ... a whole set of knowledges that have been disqualified as inadequate to their task or insufficiently elaborated; naïve knowledges, located low down on the hierarchy, beneath the required level recognition or scientificity ... it is through the re-appearance of this knowledge, of these local popular knowledges, these disqualified knowledges, that criticism performs its work.

Foucault was dissatisfied with the *totalitarian theories* that dominated research practice and advocated a non-scientific way to produce knowledge which was the re-emergence of low-ranking knowledges, not dependent on approval of the

established regimes of thought (totality, scientific research). The use of research as narrative to tell the girls' stories embraces Foucault's suggestion and shows the author's dissatisfaction with the traditional positivist way of disseminating knowledge. In that sense, the author saw the possibilities of the re-emergence of the *'disqualified'*, *'naïve'* and *'low ranking knowledges'* of the girls, which has the potential to reveal their *situational* world views and experiences.

Coffey (2007: p. 57) asserts that:

> Students and pupil experiences and testimonies can aid an understanding of student cultures and are identity-constructing processes in which people are routinely engaged.

The author views current research practice in Botswana as using power relations to discriminate against both the knowledge of practitioners (such as teachers) and 'localised' knowledge of non-academics. This contributes to further silence the voices of women and girls already devalued by the patriarchal attitudes. Writing the girls' stories, which is some form of research-as-narrative, represented a way of revolting against contemporary research practice, which emphasises academic standards (considered to be of high quality), limiting or even excluding other research possibilities. Writing up qualitative research is supposed to permit researchers to be:

> [...] liberated from some of the conventions that inhibited their creative impressions (Bogdan and Biklen, 1992: p. 197).

This paper advocates an epistemological position that recognises the informants' participation in knowledge production. The research-as-narrative story-telling write-up style that the study adopted, challenges the traditional third person singular (the researcher) and replaces it with a more personal and conceptualised first person singular approach that characterised the study. Using singularity in this way is an acceptance that other people might interpret research stories differently depending on their subjectivities.

The social world of education has increasingly been seen, and 'told', in terms of personal narratives and individual experiences. These have been conceptualised in terms of identity and biographical work – and utilised to explore the social and cultural processes of schooling. Social actors within educational arenas (teachers, managers, students, pupils) have hence been the subjects of this kind of inquiry. Studies have been concerned with exploring the lived realities of education through personal biographies, located in a social context (Coffey, 2007).

Again, within the study's epistemological framework, the author preferred to listen to what the stories 'told him' rather than what they 'told us', the emphasis being on singularity rather than universality. The preference to investigate girls in Botswana schools was a contextual strategy to move away from the 'normal' Western cultural contexts, which have been swamped with research on gender differentials in mathematics. The girls' stories were contextualised and situational, and there was no attempt to universalise them. Coffey (2007: p. 56) advises on:

> Respect for the (auto) biographical, and the teacher's (student's) voice. This recognises personal experiences and individual voices as valuable and insightful ways of understanding the everyday realities of education.

In the same spirit, Coffey advocates for understanding the relationships between learning experiences and the accounts students give of schooling. Hence the relationship between experience and narrative is key to understanding the process, practices and realities of education. This is to recognise that learning is replete with stories and narratives, which can help to reveal the complex and diverse experiences of learning and education more generally. This paper considers 'truths' to be more situational and contextualised in particular place, time and space, such as girls learning mathematics in Botswana. What constituted knowledge here were the girls' voices and the author's understanding and interpretation of their experiential frameworks.

The study is considered emancipatory by viewing knowledge from research as a story to be told from the experiences of those we want to investigate upon. This meant using the voices of those normally silenced in their cultural domain, in this case Botswana female learners, to gain knowledge of their experiences of social influences on their motivation in mathematics. Below are my interpretations of the girls' stories.

SOCIAL INFLUENCES ON GIRLS' MOTIVATION IN MATHEMATICS

In this section the author takes the reader through a descriptive analysis of the transcribed data. The author's interpretations of girls' stories, and the meaning derived therein, form the descriptions of the findings. For the reader to make sense of interpretations of the study results, the girls were given identification code names according to their abilities and the school they came from. The code names are: **Lojs, Mijs, Hijs** and **Loss, Miss, Hiss**, denoting Low, Mid (average) and High ability with 'js' and 'ss' representing the Junior Secondary and Senior Secondary school respectively.

The Family as a Social Influence

For the girls whose parents could be described as highly educated and affluent, socio-economic status positively impacted on their motivation to learn mathematics. However, it emerged that some of the girls' never got help from parents in mathematics while others relied heavily on parental support. Moreover, some were poor in mathematics yet they had attended the elitist private primary schools, suggesting that school type was not necessarily the motivation for good performance. Rather, the learners' abilities and experiences need to be explored in an effort to arouse their interests in mathematics.

Three of the girls (**Luss, Mijs** and **Miss**) came from less affluent and poorly educated families with no contribution towards their learning of mathematics. However, lack of support was not peculiar to the less affluent or poorly educated parents as some from high socio-economic status families reflected the same experiences (**Hiss, Lojs**). This suggests that for these girls, parental socio-economic status was not a clear determinant of their motivation in mathematics. Other factors such as the parents' occupation and attitudes towards mathematics might have played significant roles. Not all the parents involved could be contacted to explore these factors and their inclusion in this paper is inconclusive.

From Western social research, the family socio-economic status reportedly influences school performance (Keeves, 1972; Rosier, 1980; Ainley *et al.*, 1990). The concept of family in Western societies is, however, in contrast with that of African societies in many ways. African societies take pride in large family sizes and the tendency to prepare girls for household chores and training them for marriage, housekeeping and motherhood is very strong (Okojie, 2007). The choice of a sample from Botswana was to explore the motivational influences of girls from an African perspective where gender differentials in mathematics are underreported. Because of the differences in the levels of development between Botswana and the developed Western countries, there are bound to be differences in family socio-economic conditions such as parents' occupation, level of education, number of siblings and the availability of books in homes. There are lower numbers of siblings in developed Western families and the prospect of having books in homes is higher and the opposite is true for African families.

The study identified the separation of spouses due to employment demands as worrisome and serving to exacerbate the problem of inadequate parenting. **Hijs**'s performed poorly after her father was transferred, exemplifying the problems that this phenomenon inflicts on families, and calling into question its relevance. The other problem of inadequate parenting caused by "leaving children unsupervised for long periods" Okojie (2007: p. 10) leads to breakdown in moral standards which affect girls' learning. Okojie blamed inadequate parental supervision for the increasing teenage pregnancy in Botswana, reportedly a major cause of dropout from school by girls. The inability of the local market to absorb unskilled and semi skilled job seekers makes people seek jobs far from their families. Unemployment remains high in Botswana and those traditional trends have hardly changed.

In relation to the girls in this study, the parents of **Hiss** and **Lojs** were separated by employment. **Hijs**'s father was transferred to another town at the beginning of her final year in the junior secondary programme. **Mijs**'s mother had left to care for her ailing grandmother in their home village. **Loss** had a single parent and due to inadequate family support she sought help and support in mathematics from colleagues, which was not forthcoming. Only **Miss**'s parents lived together, but she was in boarding school in another town and her case was no better. The data suggested that the girls did not have quality time with both of their parents, let alone direct physical help with mathematics homework. Hence, they were socially disadvantaged since they lacked the parental support necessary for the development of fundamental skills needed for grounding them in the further study of mathematics.

The issue of parental support or lack of it could also be linked to the involvement of different social class structures. The theoretical implications from a Marxian view are that it is economic and material relations that determine, to a large extent, the rest of social life. In other words, larger forces such as economic power and level of education determine the basic structure of society. From a Bourdieuan perspective, this is not just about looking at capitalist mode of production, it is actually looking at the ways in which groups of people such as in Botswana

organise and determine the patterns of their existence. Although socio-economic status was not a clear indicator of differences in mathematics success, further research is required due to the sample size limitations.

As Ryan, Connel and Grolnick (1992: p. 167) found out, the girls' motivation to learn mathematics could be enhanced:

> If parents took the initiative to create conditions (at home) that facilitate learning, support, guide, inspire and promote the learning process... through understanding... what is inside the learner that leads him/her to focus on something, take interest and assimilate it.

The parents put pressure on the girls to perform in mathematics, in the form of incentives and demands for high grades. **Hijs**'s and **Lojs**'s parents wanted their daughters to emulate their respective successful elder sisters. **Mijs**'s father demanded that she emulated her mother who had been good at school. Furthermore, **Hijs** was promised a cell phone if she passed, while **Lojs**'s cell phone was to be taken away from her if she failed. **Lojs**, **Mijs** and **Miss** claimed being given pocket money as incentives and the threat to withdraw it if they did poorly. In addition, **Miss** got study guides to encourage her to improve in mathematics. All these suggest tensions between the girls struggling to learn mathematics and their parents applying control strategies to influence their learning behaviours.

These parental pressures were ideological manifestations of their culture, which point to the importance of learning mathematics. Although the application of incentives is imbued with tensions between the girls and their parents, the girls did not seem to consider such control strategies as problematic. Eagleton (1976) described ideology as that complex of beliefs, values and habits which make the existing power relations of society seem 'natural' or 'invisible'. The girls resolved the tensions by viewing their parents' behaviours as natural. As Shumway (1994: p. 153) observed, *ideology* is what the culture makes us accept without reflection.

The case of **Hijs** being promised a cell phone at a time when she was successful in mathematics could have led to the *overjustification effect* (Lepper, Greene and Nisbett, 1973) where rewarding students for engaging in activities they inherently enjoyed caused a loss of interest in that activity. Moreover, with regard to the parents' use of incentives, Deci (1971) discovered that when external rewards or other controlling strategies are used, behaviour is no longer seen as self-determined, and the individual's interest in pursuing the activity in his/her free time declines. The addition of extrinsic controls to a learning or problem-solving situation tends to limit people's creative, conceptual and flexible engagement with the activities.

In all the cases examined there was a tendency to work towards earning parental approval due to the pressures and seemingly high expectations that the parents placed on their daughters. The girls had to show loyalty to their families by meeting those expectations, which was not necessarily easy or possible in every case. The reason being that these pressures usually deprive children of the intrinsic pleasure of creative activity. Goleman *et al.* (1992: pp. 61-62) explain:

> Establishing grandiose expectations for a child's performance... often ends up instilling aversion for a subject or activity... Unreasonably high expectations often pressure children to perform and conform within strictly prescribed guidelines, and, again, deter experimentation, exploration, and innovation. Grandiose expectations are often beyond children's capabilities.

The influence of the family is imbued with factors related to family dynamics, such as how family members relate and interact with one another, family changes such as caused by death or separation and other changes. The family is a central structure of society and the source of one's morality, norms and values. In this study, the family makeup, dynamics and changes impacted on the girls' motivations in different ways. The limited interaction between parents and their children in terms of helping with mathematics and the separation of spouses due to employment or loss of a parent impacted negatively on the girls' motivations. The theoretical implications are that the concepts of social structure and social change influence and even determine not only basic characteristics of human social life, but also certain ideals and preferences.

As it is the case in most of Africa, Botswana children are not exposed to mathematics as play or through interactions with parents. The parental pressures and expectations exerted on children result from the traditional cultural values that Botswana families adhere to. In contrast with Western European countries where children tend to have a variety of opportunities for their future, the poor economic conditions in Africa make education of paramount importance to parents. The desire for families to influence their children to learn mathematics is partly in response to the realisation of its global role in modern technology, which has become an aspect of their cultural values. Parents

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have high hopes that the education of young members of the family will contribute towards the better livelihoods of other family members. This translates into high parental expectations and puts pressure on their children to perform well.

Schooling as a Factor of Influence

The school environment poses a complex web of several motivational influences including the girls' attitudes towards schooling; their experiences of the nature and learnability of mathematics; their experiences with mathematics teachers, textbooks used, and the power relations between school authorities and the students. The girls expressed affinity with each other towards school, an understanding that school provided them a platform to better careers and livelihoods. Even **Hiss**, who argued for a private tutor-dependent learning, lamented that she had no choice but to think positive about school. *'If you don't like something and you can't do anything about it, what's the use of disliking it? … It's just ok, it's school, it's there, yeah'* she protested (23 July 2008). This demonstrates her conformity to cultural mores and the suppression of her radical thoughts to gain social approval.

It is through school most of all that society expresses the importance of learning mathematics. The school as a social institution is, in Foucauldian terms, an example of how some discourses have shaped and created meaning systems that have gained the status and currency of 'truth' and dominate how we define and organise both ourselves and our social world. The girls' views are expressions of their social discourses on the value of 'school', which is accepted as reality in their society and bears no peculiarity to gender. In this sense, their utterances might be described as expressions of their pre-dispositions, their *habituses*. They see the concept of school as a right idea, but this is due to cultural conditioning; they socially acquired this discourse, which is manifested in their opinions, through enculturation. Their participation in school is largely due to having no option and therefore it makes sense to them through cultural adjustment. Hence, school does not make sense in and of itself but in the context of their *habituses*.

People, with alternative opinions on schooling are in a dilemma and are forced to conform to social norms. **Hiss** suggested preference for a private tutor and expressed dislike of everything about the formal school, but she could neither publicly voice nor sustain such radical ideas. This reflected tensions between school as a social institution and her idealised form of learning. Her ideal thoughts were beyond her family means and expectations and fell outside their cultural beliefs and traditions. Her voice on the matter had to remain silent for the sake of social harmony. This exemplifies Belenky *et al.'s* (1986) proposed women's silence perspective of knowing. The study gave the girls a voice to say the things they would otherwise not dare talk about. There are cultural constraints, which subtly forbid them to say certain things, and this is how free will is constrained in a social structure. This exemplifies how discourses impose limits on what people can say, think and do in their social milieu.

The Influence of Teachers

The girls' discourses on school were inundated with tensions between students and teachers, and expressed experiences of conflicts that dominate the ethos of schooling. The junior secondary group was very vocal on the teachers' excessive use of corporal punishment which is sanctioned in Botswana with regulations guiding its use in schools. According to the girls: *'… if you get low marks they beat us very hard, but it's not like you failed deliberately'* (**Mijs**, 6 August 2008); *'… but they should stop beating us'* (**Lojs**, 18 September 2007); and *'They also beat us, but they overdo it'* (**Hijs**, 8 August 2007). The junior school mathematics teacher acknowledged the occasional use of corporal punishment to control the students. Ironically, the girls defended corporal punishment as justified: *'… but they don't do it intentionally, they do it for a reason… if you do something wrong you have to be punished'* (**Hijs**, 5 August 2008). They resolved the tensions arising from the hegemonic behaviour of teachers by legitimising corporal punishment in order to apportion blame accordingly.

The legitimisation of corporal punishment poses a challenge and a cultural difference between the Botswana (and/or African) context and Western societies where it is unlawful. This cultural differentiation has educational implications for girls learning mathematics in Botswana. The girls in this study worried, not only about the fear of failure in mathematics to which they attach high value, but also about the possibility of being punished if they failed. Furthermore, the junior secondary school data suggest tensions due to favouritism: *'Some of the teachers… they favour other students… they like certain students and it's unfair'* (**Hijs**, 5 August 2008); *'… she focuses basically on the people who pass mathematics. People who fail mathematics, she doesn't really bother… she won't promote you'* (**Lojs**, 8 August 2008). Learners get discouraged or indeed demotivated if teachers ignore their efforts but reward their classmates.

The senior secondary group reported corporal punishment being used less partly because the student community is more mature. Both the junior and senior mathematics teachers observed never used corporal punishment during lessons. This indicates that the teachers are faced with the dilemma of whether or not to use corporal punishment even though it is sanctioned. It seems that, although they admit using it, their consciences suggest that it is not necessarily desirable and acceptable. To that end, there seems to be room even in this cultural context, to question the validity of such punitive methods.

The junior secondary group alleged that their teacher was incapable of teaching: *'Our teacher just displays mathematics and go, she can't teach'* (**Lojs**, 18 September 2007); *'Our teacher, she doesn't influence us in any way... but anyway she's not capable of teaching us'* (**Hijs**, 9 August 2007), and *'Yea, our teacher, she comes to class and leaves us to do work and she goes out'* (**Mijs**, 24 September 2007). This suggested tensions between the teacher trying her best to make students learn, and learners who devalued her efforts, making it difficult for the teacher to motivate students to learn. On the contrary, the senior school group had no qualms about their teacher's capabilities: *'My mathematics teacher in Form 4 is very good'* (**Hiss**, 8 August 2007); *'My teacher is good in mathematics'* (**Miss**, 26 September 2007); *'I would say, yea, my teacher is good'* **Luss** concurred (20 September 2007). The classroom observations did not reflect distinctively the differences between the two teachers as suggested.

There were tensions resulting from students' perceptions of the junior secondary teacher as uncooperative and keen on using coercion and favouritism, and their dissatisfaction with her teaching style. **Lojs** was particularly blunt: *'One other thing is that people who teach mathematics should be a little jolly. They should be fun to be with, that is, mathematics is one subject which is difficult, so, to make our lives easy as students, teachers should make it fun to learn mathematics, but they don't'* (6 August 2008). Such feelings have a profound effect on the learner's motivation since the liking or not liking of a particular class is based in part on a student's feelings of success within that class – feelings based not just on academic achievement, but also on their felt experiences in the class (Lockheed *et al.*, 1985).

Overall, the girls portrayed their mathematics teachers as having had no contribution to their hard work regardless of whether they had been 'good' or 'bad' teachers. They attributed their successes in mathematics to their own interests and efforts despite most of them describing mathematics as difficult, tricky and unrelated to their everyday experiences. Their experiences with mathematics teachers seemed to have led to *separation* (Griffin, 1980) where learners valued teachers for what they could do for them rather than in and of themselves. In the end it would seem that the girls felt they were not inspired by their teachers in mathematics, which suggests that the teachers did not fulfil one of their objectives of motivating students to want to learn. The separation of teachers is deceiving because it suggests that the girls felt effective and competent at mathematics, and therefore personally responsible for their successes. But most of them were not, and there was no evidence or justification for this separation.

From the girls' expressed social experiences, the teachers appeared marginalised, which was surprising given the high status that teachers occupy in the African context. The girls viewed mathematics teachers as uninteresting and uninspiring, perhaps partly due to the hegemonic means of control that the school imposes through teachers, which overshadows the sense of value for the teachers' worth. McNeil (1986) described the sort of shallow disconnected teaching seen by students in the classroom which seemed entirely consistent with Foucault's view of power. According to McNeil (1986), the institutional arrangements, in ways no one quite seems able to pin down, makes even the most able and intellectual of the teachers generally tone down their teaching to the level of the approved curriculum materials.

Many teachers have personal interest in real political, economic and social issues which they leave at the classroom door. Seeing their job as controlling their students, they seek to do this through control of the curriculum. This is why students find subjects such as mathematics uninteresting and feel that teachers do not contribute to their learning. This relates to women's ways of knowing as Belenky *et al.* (1986: p. 113) argued:

> Connected knowing builds on the subjectivists' conviction that the most trustworthy knowledge comes from personal experience rather than the pronouncements of authorities. Among extreme subjectivists this conviction can lead to the view that they can know only their own truths, access to another person's knowledge being impossible.

This in part gives a sense of why the girls tended to marginalise and undervalue their mathematics teachers.

Influences of the Nature and Learnability of Mathematics

Some of the girls were confident in mathematics and regarded it as their best subject whereas others were struggling and more likely to perform poorly at the end of their respective programmes. To some, mathematics was tricky and challenging (**Loss** and **Miss**) and to others difficult but interesting (**Mijs** and **Lojs**). All of them, however, attached high value to the attainment of mathematics success. They regarded it as a gateway to higher education (**Hijs**, **Loss**, and **Miss**) and thought it gave them prestige and high expectations (**Lojs**, **Mijs**). For **Hiss** it was a way of gaining approval from her mother who *'places a lot of importance in it'* (8 August 2007). One would anticipate that because they valued the attainment of success in mathematics, they would choose to spend more time on schoolwork which involved mathematics than, perhaps, in other subject-matter areas. However, there was no evidence that this was the case, which points to the workings of discourse that Foucault and others ascribed to.

Discourse according to Foucault refers to:

> Ways of constituting knowledge, together with the social practices, forms of subjectivity and power relations which inhere in such knowledge and relations between them. Discourses are more than ways of thinking and producing meaning. They constitute the 'nature' of the body, unconscious and conscious mind and emotional life of the subjects they seek to govern (Weedon, 1987: p. 108).

This entails how people use language to share ideas and feelings to influence others, to define and maintain communities, and to make sense of the world.

The girls attach a discourse of high value to mathematics success, yet in practice, they are not living that discourse. There is a tension between the discourse of high value and its effect, which is that one would expect them to live that discourse by working harder in mathematics. The tension arises because this discourse of high value is not the girls' own discourse. There is a tension between whose discourse it is and how it affects them. From their perceptual frameworks, it is affecting them because they tend to join in and say mathematics is important, but it emanates from the socialising and stratifying power of mathematics. In a Foucauldian sense, the girls' views are aspects of their discourses, derived from power relations. Their utterances are situated in their social, cultural, historical and linguistic contexts. This is the way in their culture that people are responding to the high value discourses. To an extent they cannot say anything else – that is unthinkable, but they are then forced to justify their positions.

There was a tendency among the girls to seek evidence of connections between success in mathematics and good future careers or connections between mathematics concepts and everyday life experiences. They tended to question the applicability of some concepts to their lived experiences and felt they had to learn them solely for academic advancement. It seems that the girls experienced the learning of mathematics as either peripheral or irrelevant to their central interests and development despite its high value. These tensions between the mathematics concepts learned and the students' negative perceptions of the applicability of such concepts in everyday life posed a hindrance to the girls' motivation.

The girls sought to see the field of mathematics come alive, to have a sense of its practical role in their lives. Belenky *et al.*'s (1986) demonstrated how women used constructed knowledge and Tobias (1990: p. 10), in support of this view, argued that:

> Women … would respond better to science if … scientific knowledge were closely and explicitly linked to important societal issues.

The girls in this study valued good grades in mathematics for various reasons. Some felt grades determined being good or poor in mathematics, earned them respect and raised expectations. Others portrayed the importance of good mathematics grades as a requirement for *the best courses* in further education. Thus, everyone strived to get the best results in mathematics despite their varying abilities, attitudes and performances with the hope of doing 'the best subjects' at respective higher education stages. This relates to the value they attach to mathematics success and demonstrates how social discourses operate. Society, through schools, has made them to believe that mathematics is a special subject in the national curriculum and they were therefore echoing a socially accepted educational discourse.

According to Skovsmose (1994: pp. 5-6), mathematics is connected to our technological culture and its importance is generally accepted far outside the mathematics and technological community:

> Mathematics education is paid an enormous amount of attention by all institutions in society. It is taken up globally – in the highly technological societies with reference to the importance of keeping

pace with social development, and in the developing countries with reference to the demands of making technological progress.

Because of this enormous attention, the girls acquired its *high value discourse* in subtle ways within their social contexts. Governed by Marxist theories of social totality, discourse is used here to extend the theory of ideology - that part of the ideological instance in which the subjects represent the imaginary relationships of individuals to their real conditions of existence. Ideology refers a system of ideas that aspires both to explain the world and to change it. Gates' (2000) argued that ideologies may be more covert systems of ideas that may achieve their expression through engaging in discourses. The girls have been disposed to value mathematics in ways that in the end feel commonsensical. In this way mathematics functions as a practical political force that society uses in an effort to promote technological development. Consequently, mathematics is used as a tool to 'weed' the student population of the weak, with implications on their future trajectories.

Mathematics grades, which are the result of tests and evaluations, are experienced as controlling (Grolnick and Ryan, 1987; Amabile, 1983). Controlling events pressure people to think feel and behave in particular ways and serve to motivate behaviour extrinsically (Deci *et al.*, 1981). The girls in this study were moved by the need to achieve success in mathematics as the achievement theorists would argue (Atkinson and Feathers, 1966). But, this need for success is driven by social goals (technological development) whose achievement rests on success in mathematics. This way mathematics is used ideologically in subtle ways to prescribe students' actual behaviours and to define or 'naturalise' possible ones.

Influences of the Peer Group Environment

The girls expressed a high value discourse for their peers as socialising was a prominent feature highlighted as motivation for attending school (apart from the lack of choice), and this extended to cooperative work in mathematics. All the girls expressed an enthusiasm for collaborative work, but some benefited immensely from it than others.

Loss acknowledged the importance of working with others: '... *you get ideas from other people and understand much better if you work together*' (19 September 2007), yet her colleagues were allegedly unwilling to cooperate: '*I never work to help friends because they refuse to work with me in mathematics*'... '*Each time I ask... them they will just tell me that they are too busy, both boys and girls*' (19 September 2007). Having a single parent, who could not help her, seemed to exacerbate her desperation for peer support in mathematics and emotionally.

Hijs expressed difficulties working with others in the final year of her school programme. From class observations, her own confessions and accounts of her colleagues, she no longer worked with others and had lost concentration, found it hard to cope in mathematics, and could no longer figure things out for herself anymore. It seemed her working relationship with others was based on personal confidence in mathematics and the fear of failure lowered her cooperative spirit. She had previously declared: '*I don't want to work to help my friends. I want to work with them*' (9 August 2007). Later, she was despondent: '*No, not anymore. I can't work with them because I don't know what to say, I can't teach them anything. I am in the dark and they are in the dark, so, they can't help me*' (5 August 2008). Her case represents a circumstantial shift from cooperation to individuation due to family social change leading to failure experiences.

On the other hand, **Miss** described a loose working relationship with friends indicating limited commitment to collaborative work. **Hiss** and **Lojs** claimed to work with friends often to help each other out, emphasising collaboration based on sharing ideas with others. They both valued their friends' cooperation and seemed to benefit from it. **Lojs** claimed that her cooperative relationship with others was based on her expressed lack of confidence in mathematics. These cases suggest the confirmation of an important feature in girls' learning – co-operation or collaboration that gender and mathematics research studies emphasised (for example, Eccles, 1987; Tobias, 1990).

The above give credit to the discourse of high value that the girls attach to peer relationships. Peers are valued for socialisation, which extends to collaboration in mathematics and other subjects. There seemed to be a tendency among the girls to rely on the peer group for support and help in mathematics than on their family members. This is a tendency to "connection and relatedness to others" confirming Belenky *et al.'s* (1986 p. 8) assertion that:

> The responsibility orientation is more central to those whose conception of self are rooted in a sense of connection and relatedness to others, whereas the rights orientation is more common to those who define themselves in terms of separation and autonomy... it is clear that many more women than men define themselves in terms of their relationships and connections to others.

There is no conflict between the discourse of high value attached to peer relationships and the acts of socialising that follow. According to Abbott (2007: p. 137):

> Research indicates that young people are highly influenced by their peer group… Perhaps conformity to peer groups is a prerequisite to achieving independence and autonomy as an adult… as the young person struggles to become independent from their parents, they use the security provided by the peer group and the self-confidence that comes with it, to take that final step towards independence.

The girls live the discourse of high value for peer relationships and this has become a fundamental reason for both attending and liking school. Building friendships and having fun with peers at school seemed to blur the real social reason for attending school - the lack of choice. For many, it reduces the burden of feeling coerced into schooling against their will and gives them the confidence and impetus to confront the everyday demands of schooling.

TOWARDS A SENSE OF MOTIVATIONAL ORIENTATION: IMPLICATIONS OF THE SOCIAL INFLUENCES

Analyses of the case studies revealed several social factors, which underlay motivational orientation towards mathematics. Each girl's ideas about mathematics and her way of applying them were coloured by her particular social aspirations in life. The girls' envisaged career goals suggested their perceptions of the role of mathematics in their future lives and allowed them to define how they identify themselves in relation to the field. Despite expressing a discourse of high value for the subject, none of them envisaged a mathematics-related career, but rather, they expressed a desire *to work with people*.

Hiss, Loss and Mijs expressed interest in studying medicine or becoming medical doctors. Moreover, Hiss and Lojs showed a desire to become lawyers while Hijs desired to become a psychologist - all based on the discourse of *'helping other people'*. For the strugglers in mathematics, their preference for jobs unrelated to mathematics is, perhaps, understandable. However, there was no exception even for those who proclaimed high ability and self-confidence in mathematics such as Hiss and Hijs. It could be that, as Hiss put it, *'girls would prefer to be nurturing'*. But this is conformity to cultural values, that is, the way girls are brought up in Botswana society, which has implications for their identity formations. The girls seemed less interested in pursuing mathematics to higher levels beyond passing their respective secondary school examinations. This, however, owes in part to the limitation of the study sample, which was not meant for generalising.

The girls tended to view mathematics as functional only in so far as it helped towards developing their non-mathematical careers in short-term. In other words, its functional significance did not seem to extend to helping them develop interests in the study of the most demanding mathematics courses offered and to persist with mathematics to the highest degree level (Forgasz and Leder, 1998). There were contradictions between the discourse of high value in mathematics success and its functional significance. Because these girls could not make tangible connections between mathematics and everyday experiences, this undermined the functional significance of mathematics in the face of the importance they attached to the subject. Perhaps the contradictions are due to the fact that the discourse of high value in mathematics success was not the girls' own discourse, and did not emanate from their own judgements of the function of mathematics. Rather it was imposed on them by society in response to the demands for mathematics in the modern world of work.

Society has made these girls to believe that success in mathematics guaranteed a better future due to the recognition of technology as the basic condition for modern development, which depends on the application of mathematics (Skovsmose, 1994). Over the years the employment structure in Botswana has adjusted to accommodate modern technology, particularly information technology. Many traditional jobs, which in the recent past required manual labour, now employ the use of microelectronics (computers). Yet, despite attaching a discourse of high value to mathematics success, the girls in this study did not seem to have an articulation of the function of mathematics in such jobs.

The case scenarios indicated further that the girls' affiliative and affectionate relationships with their families and peers, contributed to their identity formations in relation to mathematics. They were keen on co-operative work as they struggled to form working relationships with their friends. Some, such as Lojs felt they could not do mathematics on their own and needed friends to help them cope. Others wanted to be as good as their friends who passed mathematics and worked with them to *'share ideas to try to help each other understand'* (Mijs: 20 September 2007).

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Although **Hiss** expressed a desire to share work with others, she seemed to undervalue the influence of her friends in mathematics causing a tension between the discourse of high value for peer collaboration and her self-confidence. Because of her experiences of success and self-determination, sharing work with others did not amount to peer social influence. In contrast, **Loss**'s expressed lack of co-operation from peers seemed to affect her negatively in that she hoped to benefit from their contributions and support.

The girls were socialised to identify themselves and to be identified by others as either 'good' or 'poor' in mathematics, and the 'good' were associated with intellect. They internalised these social beliefs, which became self-fulfilling prophecies. For instance **Mijs** and **Lojs** claimed the need for special talent to do well in mathematics. Formal education is a social entity built on academics by intellectuals in which good students such as **Hiss** are socially accepted and rewarded, whereas poor students such as **Lojs** are socially rejected by the system. Having little opportunity to discover or develop their natural talent, they receive the label of 'low ability', which leads to the self-fulfilling prophecy. According to Coffey (2007: p. 53), "Identities are negotiated and biographies constructed through school processes, learning encounters and curricular engagement". Students who don't fit in, want out, their learning personalities are incompatible with the intellectual world, which mathematics does so well to project. This is the 'filtering' or *weeding* power of mathematics referred to earlier. It demonstrates how practical ideologies address and shape subjects (students) through discourses that point out what exists, what is good and what is possible (Berlin, 1993).

The girls' descriptions of mathematics as *easy, difficult, tricky, challenging, dull* and *problematic* are features of their social discourses constructed through their engagement in the social field. They lead to motivational traits imbued with their ideological positioning derived from the everyday practices. According to Gates (2000: p. 195):

> Michel Foucault raises the significance of focusing on the everyday practices as these are more fundamental than theory (Foucault, 1976)... is less interested in uncovering such unnoticed everyday interpretations and more interested in analysing historically situated systems of institutions and discursive practices... in which he avoids getting embroiled in debates about whether what is said is true or meaningful focusing instead on the ways in which discourses are formed and sustained.

Foucault attempted to analyse the *discursive practices* that lay claim to revealing knowledge in terms of their history or genesis rather than in terms of their truth. He embraced the idea that language and society were shaped by rule-governed systems, but disagreed with the structuralsits on two accounts. He did not think there were definite underlying structures that could explain the human condition, and thought that it was impossible to step outside of discourse and survey the situation objectively. For Foucault, there is no answer waiting to be uncovered. The *discursive practices* of knowledge are not independent of the objects that are studied, and must be understood in their social and political context. In this view, both the formation of identities and practices are related to or are a function of, historically specific discourses.

"It is imperative that the everyday realities of schooling more generally are grounded in their social and cultural, and historical contexts" (Coffey, 2007: p. 56). In this study, **Hiss** and **Hijs** whose learning personalities were in harmony with the mathematics environments were labelled 'high ability' and the others 'average' or 'low ability'. But the reality is that everyone wants to be considered of high ability, for success yields confidence, more success and acceptance. Many will seek social environments that will give them that feeling. The girls' expressed learning experiences suggested that most of them did not find the mathematics environment socially satisfying. Yet all recognised the significance of doing well in mathematics even without a sense of its practical value.

Some of the girls in the study said some things without necessarily living out what they were saying. For instance, they made connections between success in mathematics and 'good jobs', as well as it being a prerequisite for 'the best subjects'. However, there was no evidence that they worked very hard to succeed in mathematics, which means they talked certain discourses that did not necessarily impinge on their practical activities. This suggests that the discourses one uses in social structures do not necessarily influence one's practice. Their underlying *habituses* came in conflict with some of the discourses they encountered. On the one hand there is the *'mathematics is important'* discourse and the girls know it is important. But this is conflicting with some of the things they want to become such as their future careers imbued with the discourse of *'caring about people.'* They see mathematics as separate from this self-perception partly because the school portrays mathematics as separate.

The *'mathematics is important'* characterisation that the girls ascribed to is ideological. The importance of mathematics in the national curriculum is a *taken-for-granted*; everyone knows that to be the case. This discourse gives the girls the status of 'subjects' by the ideological constructions that tie them to fantasised functions and activities, not

to their actual situation. This way the culture makes these girls accept the importance of mathematics without reflection, masking very real needs to organise societies in particular ways.

Mathematics is central to some of the professions and to technological development, they know this and they have to go through it. However, school teaches mathematics in ways that force a separation between the self and the family, placing the girls in a conflict situation. They have to do it because the family believes it is part of their development and they want to please the family. Yet they fail to find a connection between mathematics concepts and their future life trajectories. In a sense, school teaches mathematics in ways that separate it from everyday activity and from the humanities. Given the context in which the girls find themselves, where mathematics is not taught as play and where the language and terminology of mathematics are unrelated to their local languages (mother tongues), the separation of mathematics from everyday discourses is rather exacerbated.

Foucault's assertion that we are all tied in social discourses surfaced in this study. The *'mathematics is important'* discourse plays a role for parents and seems to have become an element of the repertoire of *habituses* for the girls. However, it causes conflict because of the girls' *'caring about people'* discourse. The girls tend to acknowledge the importance of mathematics, but they don't show it through hard work. On the other hand they show caring for other people through forming friendships, peer collaborations and even anticipate future careers that embrace this discourse. Their acknowledgement of the *'mathematics is important'* discourse bears witness to the construct of socialisation where people selectively acquire the values and attitudes, interests, skills and knowledge through power relations. This is the way practical ideology produces its ideological effect. Social practices such as learning mathematics with social conformity and difference to school authorities are ideologically legitimate in subtle ways. They are therefore hegemonic and give rise to the concept of *commonsense* knowledge. The *'mathematics is important'* discourse itself arises as a consequence of the stratifying power of mathematics referred to earlier.

In the final analysis, there were a number of forces acting on individual learners that led to their motivation or demotivation in mathematics. Some of these forces are the discourses of the family, the church, the school and peer groups, all of which have varying influences on the individual. The case scenarios suggested that the most positive influences were reflected in peer group social relationships. There was no conflict between the high value attached to peer friendships and the collaborations forged in learning mathematics. Peer relations emerged as motivation for many to attend school and it tended to blur the fact that students have no choice. On the other hand there were conflicts between the high value attached to mathematics success and the desire to work with people. Nevertheless, peer group influences did not seem to contribute to an increase in motivations towards mathematics.

Although the girls acknowledged the importance of mathematics, they did not seem to work hard to succeed in it; hence their parents used incentives to encourage success. The influences of the family are made complex by family dynamics and social changes, which have contextual implications. Cultural contexts, which differ between African and Western European societies, render certain family influences specific to Botswana society. The common phenomenon of separation of spouses due to employment is one such a social contextual feature. Family sizes, the availability of books in homes and level of education of family members are other common points of differences. The desire for education seems enormous in Botswana due to the economic hardships most people find themselves in, hence, the high expectations and pressure on the girls to succeed at school. Schooling is valued for its role in helping young family members realise their educational ambitions so they could improve the livelihoods of other family members. Demands for success in mathematics have been accelerated by its application in modern technology and this in turn has put pressure on social structures such as the school and the family to respond.

The conflicts and tensions that exist between socially valued discourses and students' personal interests can be traced back to Hegel's theory of dialectic which suggests that history progresses through the resolution of contradictions within a particular aspect of reality. The tensions, between the girls and social forces such as family values and teacher expectations represent the struggles within society that Marx referred to. These tensions result from the practical actions of the girls within their social milieus. It is through such practical actions that the girls acquire the *habituses* that Bourdieu ascribes to. Conflict is built into society as people (such as these girls) find that their expectations and ways of living are out of step with the new social position they find themselves in. The girls are, in a way, being forced to learn mathematics due to the *'mathematics is important'* social discourse. This conflicts with their humanities related *'caring about people'* discourse, which they act out through peer relationships and relates to their future careers. The *'mathematics is important'* social discourse does not seem to have practical significance for them despite its relevance to the modern world of work. Yet mathematics, itself a cultural production, has become a form of ideology, one that legitimises the power of the state to 'filter' students for educational, political and economic purposes.

REFLECTIONS FROM THE CLASSROOM OBSERVATIONS

As part of the researcher's endeavour to locate teachers within the forms of power that Foucault and others espoused, the classes of the girls in the study were observed. During the observations the junior secondary teacher had problems managing the behaviours of some boys who were rowdy and at times disruptive. She allowed chorus responses and sometimes appeared to lose track of lesson objectives. She made efforts to control the class, but admitted that occasionally she used corporal punishment to quell the disruptions. The senior secondary class was orderly and well managed, but the teaching was no better. The teacher did the work and the students passively copied the examples or responded to the teacher as she worked problems on the board. Little attention was given to students' initiatives and investigative work that allowed them to figure things out for themselves.

In both cases no teaching aids were used during the entire observation period even on concepts requiring the use of such aids. None of the teachers attempted to explain the application of the concepts being taught. There were indications that the students viewed the teaching as 'dry' and uninspiring. For instance, the junior secondary group labelled their teacher as 'incapable' of teaching. The teaching seemed a bland, watered-down affair, which rather portrayed the teacher in total control of the subject matter. These observations echo those of Prophet and Rowell (1988) who reported teaching in Botswana as predominantly authoritarian and teacher-centred, and learning as passive and based on recall.

Teaching style, relevance, students' centredness, enthusiasm and expectations are elements of pedagogy - the art of teaching. In their pedagogy, good teachers work with students in a relationship rather than an authoritarian mode. Effective teachers don't create barriers by being dogmatic; understand that authoritarianism does not work and engage students in learning rather than the *'I teach you learn'* mode. During the observations the teachers involved did not use a variety of approaches such as having a good blend of verbal and written work, balancing writing, discussions and the use of books, as well as demonstrating with visual modelling. Furthermore, there was no indication they advocated curriculum planning around students' point of need and worked from what students knew. Cultural context requires teachers to relate to the knowledge and skills students bring with them, which are linked to their 'world', and to include local (Botswana) elements in as much of what they teach as possible. The girls in this study would prefer teachers who understood and practiced the principle that *'what you teach needs to be relevant to this day and age'*, which calls for a link between the curriculum and everyday life.

The high value the girls attached to peer culture suggested their tendencies towards collaboration and co-operation. The researcher expected the teachers to vary their teaching strategies with group work where everyone shares the problem and shares the solution, interact and help each other. This mode provides teachers with flexibility and the leeway to adjust so students engage in learning; and they (teachers) adapt and set up lessons students can achieve success. This way, teachers manage time flexibly, do not expect things to be done immediately, and accept that the task will usually get done. The teachers involved complained of lack of time and teaching facilities as the major constraints on their flexibility. This suggests that it was largely the school system's bureaucratic controls which failed the teachers and it is unfair to direct all criticism squarely on them.

The classroom observations suggested that the school was functioning in a way that attempted to socialise students into consensus mathematics, into passive learner roles. However, there were no overt community pressures or external elites insisting that the school take this social control function. It stemmed from the way the school operates as an organisation, not from outside pressures. The forces that led teachers to teach mathematics as a watered-down subject are invisible, embedded as they are so deeply and pervasively in the very structure of the school in which they work, forces which themselves are embedded in the broader society. In serving the social control function, the teachers, themselves both transmitting and being acted on by power, become part of the process by which the young are disciplined, and they themselves are controlled by the same forces. The students are controlled by the teachers, but both the teachers and students are controlled and shaped in ways much more subtle and difficult to detect.

Power works such that conformity is not the result of an overt force that visibly bends the will of those subject to its operation; but from the constant working of invisible constraints that bring us all toward the same 'normal' range of practices and beliefs. But the position of the teacher vis-à-vis power is more complex than that. While Foucault uses schools as the paradigmatic disciplinary institutions, he ignores the extent to which they are also the last strongholds of sovereign power. From one perspective teachers are themselves subject to the web of disciplinary power, however, the teacher, as seen by the student, wields power in its sovereign form. As Willis (1977) describes in *Learning to Labor*, and as Foucault would predict, the school becomes a site of resistance and outright rebellion precisely because it is a site of authoritative power. As the teacher act to impose control overtly on the students, the students can see that they are being forced to act in ways they would rather not.

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The power relations that this analysis refers to are part of the construct of socialisation through which the girls acquire the values and attitudes, interests, skills and knowledge. It is from the practical activities of the girls within the power relations at school, in the family and within their peer groups that their motivation in mathematics emanates. The classroom (as observed) did not seem to cultivate a positive motivational atmosphere for the girls in this study.

REFLECTIONS ON THE QUESTIONS: SO, WHAT WAS ACHIEVED FROM THE GIRLS' EXPERIENCES?

The essence of conducting the investigation was to suggest possible solutions for the girls' perennial poor performance in mathematics education. For this reason, the study endeavoured to answer the following questions:

1. *What is it within society or the culture that creates barriers to mathematics success for Botswana girls?*

2. *How do girls' experiences in mathematics as a social event impinge upon their motivation in the subject, which has implications for their life trajectories?*

3. *What could be done to encourage girls' participation in mathematics in Botswana in view of their social experiences given the important role of mathematics in the modern world of work?*

These questions do not require easy answers and the case studies were an attempt at addressing some of the issues they raised. The themes that emerged from the interviews offered 'social environments' as the main sources from which the barriers to success in mathematics could be influenced. Social influences, as the stories indicated, impinge upon the girls' motivational orientations and impact on their performances.

The stories indicated one distinct aspect – that the girls were discursively positioned in a somewhat unhealthy situation with respect to learning mathematics. There is the *'mathematics is important'* discourse, which is not the girls' own discourse. This discourse is ideologically entrenched in their culture – they know mathematics is important and they have to join in and say 'yes it is'. This discourse, however, is in contradiction with the other things that the girls would like to do in life – they *'would prefer to be nurturing'* (Hiss: 23 July, 2008) or to *'help people'* in their future careers. This resonates well with their cultural preparedness "their marital and maternal obligations to their families" (Okojie, 2007: p. 12).

Because of the gap between valuing success in mathematics and the failure to link mathematics to future plans, the tendency among the girls was lack of intrinsic effort. Parents, acting out of desperation, use extrinsic incentives – such as items of luxury (cell phones) and money - in an effort to lure their children to want to learn mathematics. At the same time the parents are not actively involved in helping their daughters with mathematics homework. Their culture promotes tensions between the girls and their teachers (school authorities) by sanctioning hegemonic means of control such as corporal punishment in schools. This puts teachers in a dilemma situation of whether or not to use corporal punishment, and further creates tensions between teachers and their superiors.

The downside of external incentives and corporal punishment is that learners may feel controlled. Research studies have shown that learners who perceived their achievement related behaviours to be controlled by external forces, such as teachers' use of highly controlling behaviours, are less likely to initiate and explore (Bandura, 1982). Furthermore, the *cognitive evaluation theory* states that when external rewards or other controlling strategies are used, behaviour is no longer seen as self-determined, and an individual's interest in pursuing the activity in her/his free time declines (Deci, 1971). There were clear protests against corporal punishment and suggestions of tensions from pressures disguised as parental support in mathematics.

These girls also have the disadvantage of mathematics as alienated from their indigenous languages and other forms of early learning. They therefore see it as belonging to the school. They live in a culture that condones the separation of parents due to employment demands, which may be detrimental to the child's education. Furthermore, the stories suggest that for this group of girls, social class was not a clear determinant of success in mathematics. This may be due partly to the cultural differences between African and Western societies. In the latter, social class was found to contribute to mathematics success. It may also be due to the limitations of the sample size, and further investigations would be appropriate. The author is careful to avoid generalisations, which were never intended due to the study's epistemological approach.

The girls in this study showed an affinity towards collaboration and co-operation. There were no tensions for peer affiliation, and even those who did not work with others felt denied that opportunity. This is within the parameters of their cultural upbringing, with emphasis on girls and women taking care of other family members (Okojie, 2007).

The stories also indicated that the girls could not make connections between concepts learnt in mathematics and everyday life. Confident and self-motivated girls such as Hiss, lamented, *'I go to school, I learn a whole lot of*

things which I don't know if they are useful in life. What do I need indices for? Nothing... I mean, having all the numbers in the world and knowing maths wouldn't get you anywhere...' (23 July 2008). **Lojs** added: *'I don't know why it is given such importance'* (8 August 2008). The girls found it difficult to link mathematics to everyday activities. This lack of coherent connections causes tensions and dilemmas, as the girls ponder on why they should continue to learn a subject, which has no significant value for them in real terms.

In the end, these girls seem to be struggling on with mathematics out of lack of choice without any suggestion that they have any motivation for doing so. It seems that the knowledge that mathematics is important puts pressure on the girls to aim high in the subject. At the same time, the abstract nature with which mathematics is held in society, the way it is taught at school, the lack of connection to everyday activities and parental pressures, all lead to anxiety, which undermines their motivation. Their performance in mathematics is for reasons separate from its inherent satisfactions. By the end of the research most girls were relatively poorer in mathematics than at the beginning. In other words, there seemed to be a progressive decrease in intrinsic motivation for class work as the girls advanced through school.

The stories suggest that the girls' lives were being compartmentalised by regulating their behaviours according to situational and social needs. Mathematics has found a role in the compartmentalisation process because of its link to technology, the basic mode of development. This makes mathematics an ideological production which serves to *'filter'* learners for social and political purposes. The prevailing cultural attitudes, which undervalue the education of women in Botswana, have contributed in the construction of girls to feel in a 'normal' situation. Their motivational orientations appear as individual misfortunes or efforts, yet they emanate from influences ingrained in their acquired dispositions, that is, their *habituses*.

LIMITATIONS OF THE STUDY

Financial resources and other social events were constraining issues in this study. It was initially intended to be a longitudinal study over two years, but my sponsorship could not cover the financial costs involved. Data collection was divided into two phases each taking six months, but there were time constraints on the field due to the sample schools' timetables. In some cases meetings with students had to be re-scheduled as the schools demanded. Because there was a discontinuity between the two phases of data collection, the author relied on the girls' narratives of their learning experiences rather than on rich anecdotes that participant observations in a longitudinal study could have offered. This denied the author the opportunity to get a more comprehensive understanding of the issues raised in this paper.

A small group of six girls was selected with a view to get an in-depth view of the forces that most influenced their motivation in mathematics. As it turned out, the sample size became a limiting factor on the conclusions that had to be made. However, it should be understood that the aim was not to generalise findings, but to gain a better understanding of the issues under investigation.

The theoretical framework and literature review relied heavily on Western research which poses a limitation on the transferability to the African situation due to differing cultural trends and traditional practices. The author's experiences of having taught mathematics in both Botswana and England (Nottingham) showed a clear divergent classroom practices at work. The teaching of mathematics in Botswana, although itself an imported Western tradition adopted from the UK, poses some limitation in terms of the operationalisation of concepts as understood from a Western research perspective. A more traditionally Botswana or African theoretical approach if available could have shed more light on the impact of the social influences on the girls' motivational orientations, and this calls for a further grounded theoretical study to generate such a theory.

Some, particularly from the feminist approach, may view the research conducted by a male on female learners, as a limitation. The author does not consider it as such because the approach questions the disenfranchisement of female learners in Botswana and has personal as well as social implications.

CONCLUSIVE SUMMARY

The study that this paper refers to is unique in that it addressed a national problem of improving the image of female learners in mathematics, which is a contemporary issue in the African context and the rest of the developing world. The problem of emancipating women and girls from social attitudes that tend to keep them in positions of subordination has become a concern for developing countries, who until recently viewed it as a Western phenomenon.

This study adds an emancipatory voice to the plight of girls in learning mathematics in Botswana, and Southern Africa. The case study project contributes to a journey that could expand research on gender differentials in mathematics education in the region and beyond. Women are a formidable force in economic development in all parts

of the world, yet their efforts are still undermined through cultural and traditional means that relegate them to devalued social roles that most developing societies recommend for them. As the case study scenarios indicated, a number of social forces compete to influence girls' motivation in mathematics education.

Transformation of existing beliefs and attitudes towards girls and women is the ultimate aim. Since the principle sources of data are secondary school girls, to some extent, the education system of Botswana is subject to critical enquiry. To that end, the study critically examines the role of education in the motivation of female learners towards mathematics. Education in this context is part of a wider social structure and a vehicle for advancing the learning experiences of young members of society.

The nature of case studies is such that they focus on specific instances or situations and explore the various interactive processes at work within those situations (Hitchcock and Hughes, 1989). As Kilbourn (1999: p. 31) put it:

> Theses are made of parts. Seldom are all parts outstanding. In this thesis, I'm holding, the data are fantastic, even though the analysis is not as strong as hoped. In that study, over there on the shelf, the analysis is penetrating, although the database is a bit thin.

The author recognises that there is no single complete *truth* but that there are multiple discourses of truth in a particular time, place and space. For the author, research is an ongoing process, and this research is an unfinished business, which enabled the researcher to grasp the partial realities in a particular spatial context. The conclusion of this paper became a difficult undertaking for the author who saw it in the form of a continuing enterprise and therefore preferred to describe it as a *'pause'*. The case study scenarios revealed issues related to further research. By revealing how the girls are discursively positioned to view mathematics as important, but with no sense of its meaningfulness in practice means further research need to be conducted to find out whether this is a general view in Botswana or Southern African sub-region.

The problem of story telling as a way of representing the silent voices is another issue of contention. The question of the voices of learners in general has not been fully addressed as it is beyond the scope of this paper. This research, however, attempted to represent the voices that are normally kept silent. Students' voices are not commonplace on educational matters that affect their learning. They are kept silent by the school culture with its wider social values. The voices of the study's informants only partially reveal the active silent voice. Most research projects are keen on asking students to fill questionnaires from which generalizations are made. This way, students are treated as sources of information without recognizing their human face. It would be fruitful to look at how learners are discursively positioned to keep silent in order to create channels for them to tell their own stories concerning their learning.

Through embarking on this study, the author was somewhat challenged and changed by it. Having been accustomed to research as proving whether a given theory stands or falls apart, through statistical anecdotes and generalizations, the study provided the experience of research as also about getting a deeper understanding of issues of interest. The author also learnt that research work is not an easy undertaking and cannot reveal only one *'truth'*, but that *'multiple truths'* may emerge depending on individual interpretations. One of the informants said: *'This tape recorder reminds me of the police'* which demonstrates how respondents may associate research with other aspects of their social lives, which may affect their responses.

The research helped the author to know more about Botswana and its attitudes towards women and girls, and that it is by standing back and trying to see things from a distance that one learns more about his/her own social contexts. Unless one has some issue to protest, it is difficult to see one's social structure as problematic. The author learnt how cultural attitudes were influencing the upbringing and education of girls in Botswana.

The author concedes that he does not possess the eloquence of reproducing his research endeavours by word of mouth and wish to align with Schon (1987, p. 49) who argued that:

> When we go about the spontaneous, intuitive performance of the actions of everyday life, we show ourselves to be knowledgeable in a special way. Often we cannot say what it is that we know. When we try to describe it, we find ourselves at a loss, or we produce descriptions that are obviously inappropriate. Our knowing is ordinary tacit, implicit in our pattern of action or in our feel for the stuff which we are dealing with. It seems right to say that our knowing is in our action.

The gender and mathematics problem remains a concern for Botswana as the BGCSE results continue to show that doing badly compared to boys. The Examinations, Research and Testing Division of the Ministry of Education (2007) Examination Summary of Results, p. 13) acknowledged that:

> As in previous years, the overall performance of male candidates (as measured by the % of grades issued which are C or better) was significantly better than that of female candidates. For all subjects, 42.22% of the grades awarded to male candidates are grade C or better. For female candidates the corresponding percentage is 39.70%.

The significance of further research in this area cannot be in doubt.

POINTS OF DIRECTION: LESSONS FOR EDUCATION AUTHORITIES

This section raises issues that government as the custodian of the people of Botswana should take into account to help female learners in the face of a barrage of influences on their motivation in mathematics. This could foster an awareness campaign for education planners, curriculum developers, textbook authors and teachers on the problems faced by girls in learning mathematics. Ultimately, curriculum policy, syllabuses, textbooks and lessons could be designed to address girls' interests in mathematics education.

- Government should introduce infant schools where mathematics could be taught as play to prepare children for the appreciation of mathematics at later stages. The girls described mathematics as tricky, difficult, tough, boring, problematic, etc. partly because they view it as a school-based subject divorced from their everyday experiences. If they learn it early in their development, this could dispel some of the myths attached to the nature and learnability of mathematics.
- More resources should be put in schools to enable teachers to facilitate the learning process rather than dominate the classroom discourse. The classroom observations, the girls' and teachers' views suggest that teachers would do better with modern supportive teaching aids. This could improve teaching and boost the image of teachers who the girls regard as ineffectual.
- Gender awareness courses should be introduced in teacher education colleges to combat patriarchal attitudes that prevail in Botswana with negative impacts on female learners. Botswana still harbours such attitudes, which have detrimental effects on girls' efforts in mathematics and on their career choices.
- The integration of technology into education should be accelerated. Information technology should be part of the school curriculum since it has become a global driving force in career opportunities. The girls expressed awareness of the importance of mathematics in education and the use of ICT in learning mathematics could boost their interests and help their understanding.
- Corporal punishment should be abolished in schools. Teachers are viewed as hegemonic and controlling through its use. Teachers in this study seemed to be in a dilemma as to whether to use it (because it is sanctioned) or not to use it on moral grounds. The girls expressed feelings of being intimidated by the use of corporal punishment. Well-trained teachers can do their work without the help of such harsh methods of control, which often give students strategies to resist and lose focus on learning.
- Government should consider labour or employment legislation that attempts to consider the problems related to family dynamics that affect children's education. The case scenarios call into question the practical implications of the existing policy.

If government took these measures into consideration, the factors that negatively influence the girls' motivation and participation in mathematics could be minimised.

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