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THE LOWER PRIMARY MATHEMATICS CURRICULUM:

A CONTEXTUAL ANALYSIS

1. INTRODUCTION

Political independence in Namibia in 1990 dawned with a paradigm shift in education and the system opened up for all Namibians, including the previously deprived or marginalised. Article 20 of the Namibian Constitution states:

> All persons shall have the right to education. Primary education shall be compulsory and the State shall provide reasonable facilities to render effective this right for every resident within Namibia, by establishing and maintaining State schools at which primary education will be provided free of charge (MEC 1993:3).

Seven years later, at the first sub-regional conference on curriculum development in Southern Africa, held at the National Institute for Educational Development (NIED) in Okahandja, Namibia in January 1997, the Honourable Nahas Angula, Minister of Higher Education, Vocational Training, Science and Technology, said in his opening remarks:

> Looking back..., the profile of education and training has radically changed: a unitary system of education has been established; a new language policy is in place; a new organisational structure adopted; a new curriculum developed; new instructional and learning materials are being tested and implemented in schools; new teaching methods are encouraged; and a new uniform teacher education programme is being implemented. In short, a national comprehensive system of education and training is emerging...The process continues (Angula, in Avenstrup 1997:19).

The purpose of this analysis is to critically evaluate the Lower Primary Mathematics programme within the context of the Namibian educational reform, against the backdrop of learner-centred education from within the Constructivist epistemology. Through the analysis of a small-scale survey, I will try to determine the extent to which learners, teachers and other educationalists, involved in the Lower Primary school phase, understand the new approach to Mathematics and their pedagogical and theoretical insight into the new programme. I will also analyse the syllabus documents in view of the educational policies and further discuss the social, historical and economic background to the reform. I will then analyse the progress or development of the reform process through discussing the learning environment as well as the learners who are the central participants in education.

2. METHODOLOGY

The Research Design

The research design involved a survey and a document analysis to determine the extent of the understanding and practice of certain key concepts in policy and curriculum documents, and knowledge of the conceptual framework of the Lower Primary Mathematics programme. It entailed selecting categories based on curriculum and policy documents, developing criteria to indicate conceptual understanding and developing research instruments based on these categories. Three categories were selected from key principles of the educational reform of Namibia and key documents of the Mathematics programme. They are firstly learner-centred education situated in the Social Constructivist philosophy as approach to the reform of education; secondly the four major goals of education, culture and training namely access, equity, quality and democracy; and thirdly knowledge and understanding of syllabus content, teaching methods and textbooks.

The following nine criteria, based on the above categories, had been chosen for analysis:

- To what extent does the respondent know the content of the Mathematics syllabuses?
- To what extent does the respondent understand learner-centred education?
- To what extent does the respondent understand new teaching methods/strategies?
- What are the respondents' opinions on the Mathematics syllabuses?
- What are the respondents' opinions on the materials available?
- What are the respondents' opinions on the strengths and weaknesses of the programme?
- To what extent does the respondent understand the four major goals of education?
- To what extent does the respondent understand the promotion requirements?
- What are the teaching outcomes from the perspective of the learners?

Data Collection

The Questionnaires

I developed three questionnaires, one for Lower Primary Curriculum and BETD Panel members, one for Lower Primary Mathematics teachers, and one for grade four learners.

The questionnaire for Curriculum Panel members: The first eight criteria had been used for this first questionnaire. They were handed out during the panel meetings, with an explanation of the purpose of the questionnaire. A sample of 17 practising Lower Primary educationalists responded. They were from all 7 educational regions, ranking from class teachers, Heads of Department, Advisory Teachers to Teacher Educators.

The questionnaire for teachers: The second questionnaire consisted of the first six criteria. A sample of 17 teachers responded. They were all qualified Lower Primary teachers who do class teaching and thus teach Mathematics.

The questionnaire for learners: The last questionnaire was developed as an afterthought. It aimed at seeing Mathematics from a learner-perspective. A sample of 90 grade 4 learners was taken from two different Windhoek primary schools.

The Interviews

I conducted two face-to-face interviews with colleagues, mainly to acquire information on the reform process and curriculum development from the perspective of the National Institute for Educational Development (NIED). I interviewed two colleagues simultaneously the second time around, but then from a Lower Primary perspective. Due to unforeseen circumstance, none of the two interviews could be tape-recorded, but detailed notes were taken throughout. After the write-up, the scripts were e-mailed to the colleagues to check for accuracy.

Data Analysis

I read through each questionnaire thoroughly and I tried to allocate scores on face value of what each respondent had answered on each question. For each individual, I tallied the scores for each of the criteria, after which the number of persons per score was carried into the appropriate tables (see Tables 1 & 2). In the case of the Lower Primary Panel members I found a significant relationship between knowledge of the syllabus content on the one hand, and respondents' critical evaluation of the strengths and weaknesses of the programme on the other hand. As panel members who are involved in the evaluation of textbooks, I found them to have insight in the broader spectrum of materials available. Although I did not ask a direct question on their understanding of learner-centred education, I could derive from the cliches that respondents have a general idea of the concept. What was disturbing, is the poor insight in promotion requirements and the poor knowledge of the policy of education.

Table 1: Number of Lower Primary panel members per score

Criterion	Poor =1	Under av. =2	Above av. =3	Excellent =4
Evaluation of the mathematics programme	4	2	3	8
Evaluation of the strengths of the programme	2	4	2	9
Evaluation of the weaknesses of the programme	6	2	4	5
Knowledge of the syllabus content	0	3	12	2
Understanding of the promotion requirements	6	4	5	2
Understanding of the four major goals of education	10	3	1	3
Understanding of new teaching methods/strategies	1	2	8	6
Evaluation of the materials that they use	1	2	4	10
Understanding of learner-centred education	2	4	6	5

In the case of the teachers I again found a significant relationship between knowledge of the syllabus content on the one hand and respondents' critical opinions on strengths and weaknesses of the syllabus on the other hand. Teachers have a very limited experience of available textbooks and they use only the class copy. Again the cliches, e.g. "from the known to the unknown" and "learners discover for themselves", indicated that respondents have a general idea of learner-centred education. It was disturbing to observe the poor insight in integration as a teaching method, and the poor knowledge of the policy of education. I also found that teachers generally have a good knowledge of the syllabus for the grade they teach, but poor knowledge of where the learners come from and where they are going.

Table 2: Number of Lower Primary teachers per score

Criterion	Poor =1	Under av. =2	Above av. =3	Excellent =4
Understanding of learner-centred education	3	2	9	3
Understanding of gender/culture bias	7	8	1	1
Evaluation of the strengths of the programme	0	1	8	8
Evaluation of the weaknesses of the programme	6	2	7	2
Understanding of new teaching methods/strategies	1	8	6	2
Evaluation of the materials that they use	1	5	5	6
Knowledge of the syllabus content	0	8	9	0

Reading the responses on the questionnaire for learners, I could derive an indication whether learners could draw strings between the subject and real life situations. I found that the average learner definitely does not have a good idea on the significance of Mathematics or the purpose of the subject.

Reflections

My instruments consisted mainly of open-ended questions and respondents could speak their hearts. Some questions, however, were a little too vague to get the information that I desired and the space for remarks not adequate enough. In the questionnaire for learners the key question gave me the necessary information, but the other questions were of no significance for this study, other than it showed that learners are not used to (or skilled at) critical reflection. A rating scale questionnaire would have been more purposeful in this case.

The information that I gained through the interviews was very helpful for the socio-historic analysis of this study. The people that I interviewed were part of the Namibian educational reform process right from the beginning. The first interviewee has wonderful insight in all the decisions and forthcoming processes of all the different school phases. She is a critical thinker, who is conscious of the shortcomings, but also very proud and positive about the achievements and outcomes of the reform process to date. For her, it was a tough and challenging experience, but very rewarding. As she rightfully said: "The reform is exciting and challenging. It is dynamic and never static. One could not predict or plan exactly what could happen, but take a leap and hope for the best" (Appendix D).

Next I will critically engage in the policy and syllabus documents of the Mathematics curriculum against the backdrop of the Social Constructivist epistemology.

3. CRITICAL ANALYSIS OF THE LOWER PRIMARY MATHEMATICS PROGRAMME

Social Constructivism as Epistemology

Namibian education emerged from a closed-system Behaviourist philosophy, which resulted in a hegemonic view of curriculum. Teachers' focus was on packaging and delivering content within a fixed curriculum. Learning was seen as the hierarchical transfer of knowledge, a clear distinction between comprehension and application (Taylor and Campbell-Williams 1993, Prawat 1992). After Independence Namibia has committed itself to education based on the Constructivist view of knowledge and associated theories of learning with "...learner centred education as a philosophy rather than a methodology" (Parsons 2001:10). Parsons claims learner-centred education to be:

> [A] starting point from which every aspect a [*sic*] teaching and learning develops. It is firmly rooted in constructivist theories of learning and epistemology that sees knowledge as constructed by the individual based on his/her previous experiences and developed through interaction with peers, teachers and recognised bodies of knowledge (*ibid.*).

In the introduction to his paper on Social Constructivism Paul Ernest (1993:1) remarks: "An increasing number of mathematical educators identify themselves as constructivist researchers or constructivist teachers. Many positive consequences flow from this position, for it embodies a powerful vision of the active and epistemologically empowered learner". It is from this perspective that I will aim to analyse the Lower Primary Mathematics curriculum.

The Guiding Policy for the Reform in Namibia: Toward Education for All

> "Toward Education for All – A Development Brief for Education, Culture and Training" is a policy document, which translates the Namibian philosophy on education into concrete and implementable government policies (Nujoma, in MEC 1993:i).

According to the policy, the Ministry of Education and Culture will assign the highest priority to four major goals and to those activities essential to reaching them: *access, equity, quality and democracy*. The key criteria for educational reform in Namibia are learner-centred education, lifelong learning, human resource development through education improvement and training, and unity in diversity. Achieving *Education for All* is a partnership between government as the main role-player and active participation of local communities, public and private enterprises, and international and foreign agencies (MEC 1993).

The Pilot Curriculum Guide for Formal Basic Education

The *Pilot Curriculum Guide (or Broad Curriculum) for Basic Education* (MBESC 1996) indeed reflects the change in education that came with independence for Namibia. It also reflects the four major goals for education, culture and training as portrayed in the guiding policy, and the principles of learner-centred and lifelong education are clearly spelt out in the *Broad Curriculum*. In order to bring about change in an education system, the *Broad Curriculum* should give a clear guidance to teachers as changers of education and curriculum developers. Hence, among others, there are certain criteria a post-modern curriculum guide should reflect.

The *Broad Curriculum* should set the framework for the acquisition of the necessary fundamental knowledge and understanding, skills and competencies, and the attitudes and values

which are needed for an adequately functional society, and the fulfillment of the individual. Knowledge in formal education is structured into areas of learning and in subjects, but this is not the way in which problems and issues are presented in real-life situations, and therefore learning should be experienced through cross-curricular and integrated thematic approaches. The curriculum should provide the foundation for further study and development beyond Basic Education. It should also provide a basis for achievement through the construction of knowledge in a variety of social settings, both in- and outside the classroom, rather than the transmission of facts. It should further provide learners with learning experiences of active involvement in the various strategies of learning and resources that influence conceptual understanding. It should promote critical thinking and questioning, open discussion, creativity, experimenting and discovery. The curriculum should reflect a holistic view of learning, which values existing knowledge, skills and interests acquired through previous life experiences and cultural values and lifestyles. Lastly, the curriculum should supply appropriate assessment strategies, located within the learner-centred principles, to evaluate the desired outcomes of teaching and learning through the demonstration of competency in knowledge, skills, values and attitudes.

My opinion is that the *Pilot Curriculum Guide for Formal Basic Education* provides a sound framework for the development of subject syllabuses in general, for the Lower Primary Mathematics programme specifically, and for teaching practice. (Set aside the Map of the Curriculum, which is not a true reflection of the "heart" of the Curriculum Guide.)

The *Broad Curriculum* (MBESC 1996:5-9) envisages the Lower Primary Mathematics programme to:

- develop positive attitudes towards Mathematics;
- enable learners to acquire the basic number concepts and numerical notation;
- enable learners to understand and master the basic mathematical concepts and operations;
- enable learners to apply mathematics in everyday life;
- develop a lively, questioning, appreciative and creative intellect, enabling learners to discuss issues rationally, to make careful observation and analysis, to experiment, to think scientifically, solve problems, and apply themselves to tasks;
- help learners develop self-confidence, self-knowledge, self-reliance and understanding of the world in which they live through meaningful activities;
- provide for individual needs and aptitudes within the framework of common curriculum, including compensatory teaching at classroom level;

- enable learners to obtain the knowledge and understanding, skills and competencies, and attitudes and values needed for their personal development, related to the changes in Namibian society;
- equip learners to play an effective and productive role in the economic life of the nation;
- promote positive attitudes towards the challenges of co-operation, work, entrepreneurship and self-employment.

The Lower Primary (grades 1-4) Mathematics Syllabuses

The aim for the document *Guidelines for Syllabus Writing* is "to provide guidelines to Curriculum Panels/Committees and Working Groups on the procedures to be followed in the development and approval of syllabuses" (MBESC 2001a:1). It provides clear details on the format and layout, with specific divisions or sections that a syllabus document should have. Following is a discussion of the Lower Primary (grades 1-4) syllabuses in relation to the guidelines.

The introductory part of the grade 4 syllabus gives a good account of the aims for the development of functional numeracy and mathematical thinking, and also the aims for intellectual development, as portrayed in the *Broad Curriculum*. But then it proceeds with the statement: "The syllabus is designed to give a complete statement of the scope of the content to be covered, but not the details of sequencing. The teacher *may* [emphasis mine] integrate topics where possible" (MBEC 1999a:3). This statement is in opposition to the integrated learner-centred approach to teaching and learning (and not *instruction* as mentioned further on). *Geography* is mentioned twice in this section, as if it were a grade 4 subject. In fact, Geography as a subject appears only in the Junior Secondary phase. Sections titled *English as Medium of Instruction, Learning Content* and *Methods* are totally superfluous as syllabus content and could be a concise part of the *Introduction.* These may, however, serve a very useful purpose in a Teachers' Guide. The section titled *Methods,* for example, provides a list of learner-centred ideas in relation to Mathematics.

The *Guidelines for Syllabus Writing* defines *aims* as "general and specific goals of the subject" (MBESC 2001a:3), whereas the *Broad Curriculum* defines *goals* as "statements of values and policy which are the foundation of Basic Education" (MBESC 1996:4). The *Rationale* for the Mathematics syllabuses was taken from the 1995 edition of grade 4 Draft Mathematics Syllabus

(MBEC 1995), developed as part of the Upper Primary reform before grade 4 became part of the Lower Primary phase. Reference to numerical development is incomplete in the sense that only number operations; money, measurement and space are named. Pleasure and satisfaction, it is stated, can be derived *only* from problem solving, puzzles and games. It is further stated that: "Mathematics should have a sufficiently broad base to provide basic *training* [emphasis mine] for future study in Mathematics", and further "The abilities to be assessed in Mathematics cover a single domain, *technique with application*" [emphasis mine] (MBEC 1996a:1, 1996b:1, 1997:1 and 1999a:6). Other aims, however, are in accordance with learner-centred outcomes, e.g. understanding of concepts, using a variety of mathematical processes, cooperative learning, expressing ideas meaningfully, etc.

It should be vitally important to include the following aspects in the rationale and aims of the syllabus document: 1) learner-centred education as situated in Social Constructivism as guiding principles for the Namibian educational reform; 2) the desired outcomes of teaching and learning as identified by the *Broad Curriculum* as the basis for the Lower Primary Mathematics programme; 3) the integrated thematic (or problem-based) approach linked to Mathematics for the development of conceptual understanding; and 4) compensatory teaching for learners with special learning needs. The interpretation of the conceptual framework of the syllabus could else remain a matter of compartmentalised 'training' of mathematical facts, rather than conceptual understanding.

The learning content of the syllabuses is sub-divided into *Themes and Topics*, *Learning Objectives* and *Basic Competencies*. The format of the grades 1-3 syllabuses is much the same, but the grade 4 syllabus differs in the sense that it has some general aims listed under each of the themes. An extra column indicates which Basic Competencies are revision only (R), revision and extension (RE), or new work (N). The survey found that many teachers complain about the workload of the grade 4 syllabus, and that some topics indicated as 'revision', is in fact new work.

The *Guidelines for S*yllabus *Writing* provides definitions and clear indications of the different components of the syllabus content. It draws a distinction between *Learning Objectives,* defined as *intended outcomes,* and *Basic Competencies,* defined as *achieved outcomes.* It further states that all the learning domains (viz. Cognitive learning, Affective learning, Motor Skills learning, Interpersonal Skills learning) and their different levels, should be covered in the formulation of

Basic Competencies (MBESC 2001a:4-5). The grade 4 syllabus defines *Learning Objectives* as "... ongoing, continuous outcome statements of learning processes going on through the year" and *Competencies* as "... the level of performance expected from the learner" (MBEC 1999a:11). The *Broad Curriculum* further makes a distinction between *Basic Competencies* (What a learner should be able to do as the outcome of teaching and learning) and *Life Skills Competencies* (viz. Investigating, Interpreting, Applying knowledge and skills, Communicating, Valuing and Participating).

The integrated approach to Mathematics caters for learning across all domains.

Cognitive Learning: Knowledge and comprehension are acquired through conceptual understanding of numbers, their order and patterns. These can be applied in measuring activities and problem solving, and through creative activities like making graphs or shape creation. It is also the subject of articulating ideas of number concept and of accuracy and precision.

Affective Learning: Some of the key elements in acquiring a positive attitude towards Mathematics are to seek or give information; to raise and respect opinions and/or suggestions; to agree or disagree; to respond to other learners' explanations; and to critically reflect on own strategies in order to identify and correct mistakes.

Motor Skills Development: Mathematics is *the* subject that offers the opportunity for manipulating concrete materials through measuring, money activities and shape creation.

Interpersonal Skills Development: In group activities learners have the opportunity of sharing and receiving knowledge and skills; discussing strategies applied and attending to other's needs

Taken into account that different working groups were involved in the development of the Mathematics syllabuses for the different grades, the programme has a good scope and sequence, catering for progression in the teaching and learning levels. However, there are a number of shortcomings in the content of the syllabuses to be addressed in future review. Although the integrated problem-based approach has been adopted for mathematical change, the Basic Competencies mainly reflect achievement of knowledge, skills and understanding in the domains of *Cognitive Learning* and of *Motor Skills Development*. Basic Competencies in the domains of *Affective Learning* and *Interpersonal Skills Development* should be added for the development of Life Skills Competencies and of values and attitudes, and to accommodate the holistic view of education. Amongst other, I would suggest that the themes, topics and sub-topics of the various syllabuses should be brought in line with one another. The Basic Competency for *Problem Solving,* which is one long, incoherent sentence, could be rephrased into a few simple

competencies. The theme *Entrepreneurship* should be brought into the Lower Primary Mathematics programme as suggested by the *Presidential Commission* (Government of the Republic of Namibia 1999).

Stenhouse (1981), criticising Tyler's *Production Curriculum Model of Behavioural Objectives* and Bloom's *Taxonomy of Educational Objectives,* votes for a *Process Model* comprising of four different processes in curriculum development. They are: 1) *training* - concerned with the acquisition of skills; 2) *instruction* - concerned with the learning of information; 3) *initiation* - concerned with the social values and norms; and 4) *induction* - concerned with the introduction into thought systems that will result in understanding and making judgements. My opinion is that the syllabuses are still "expressing learning in discrete, quantifiable and linear units" (Doll 1989:244), catering well for the *training* and *instruction* aspects. It is more a bridging model with little evidence of participation and critical thinking. However, I do think that our education system still needs to be more structured, gradually developing towards an open-system model of internal transformation as our teachers become more empowered. "A post-modern curriculum must allow time for this internal restructuring to take place" (Doll 1989:250).

The grade 4 syllabus contains a 4-page elaboration on the *Assessment* part of the grades 1-3 syllabuses, taken from the *Broad Curriculum* and *Towards Improving Continuous Assessment In Schools: A Policy And Information Guide* (MBEC 1998). The *Guidelines for Syllabus Writing* (MBESC 2001a) provides clear and detailed requirements for the assessment section of the subject syllabus: how marks should be allocated, the criteria for assessment and the purpose, types, implementation and recording of assessment. Another requirement is that the assessment domains for the subject be spelt out clearly, which can be some or all of: "Knowledge with Understanding; Explanation and Interpretation; Application of Knowledge; Investigation and Participation" (MBESC 2001a:6). Compare here the statement in the *Aims* section of the grades 1-3 syllabuses that the only domain to be assessed is that of 'technique with application' (MBEC 1996a:1, 1996b:1, and 1997:1).

The *Assessment* sections in the grades 1-3 syllabuses, on the other hand, give a broad outline of Continuous Assessment in the Lower Primary phase: the purpose, types and criteria of assessment and promotion. With the grade 4 reform, the *Continuous Assessment Policy Guide* (MBEC 1998) was already in place and key information on *less and more structured assessment* could then be added. In an effort to accommodate *all* the issues from the policy guide and the

Broad Curriculum, the section became too bulky and it lacks coherence, because some points are repeated and some had been omitted. Continuous Assessment is one of the main indicators of learner-centred education. It is thus essential that the key documents within the curriculum give its audience explicit guidelines. "The most well intentioned curriculum or educational reform survives only to the extent that the examination or assessment which accompanies it also changes" (Nyambe, in Avenstrup 1997:46).

Here it is interesting to take note of the promotion requirements for the Lower Primary phase in Namibia as portrayed in the MBEC Circular on *Requirements for Promotion* (MBEC 2001b:4). Subject to the provision that no learner shall repeat more than once in the phase, "a learner who has an E-symbol in the language used as the medium of instruction should not be promoted to the next grade". Also, "a learner who has an E-symbol in Mathematics is a borderline case and repetition could be considered, taking into consideration performance in the other subjects". Teachers' limited knowledge of the promotion requirements and misconceptions on automatic promotion are really alarming. One of the reasons for these might be their own experience of a Behaviourist school system in which many had been taught and trained to teach. Next I will aim to give a short overview of this very system.

4. THE SOCIO-HISTORICAL AND ECONOMIC SITUATIONAL ANALYSIS

"Before 1977, while South Africa governed Namibia, the majority of learners in Namibia were obliged to follow the Bantu Education programmes of South Africa. These were inferior to what South Africa provided to the white learners in Namibia" (Alberts, in Avenstrup 1997:89). Political injustice at that time was the sole cause of an imbalanced education system that will take years to rectify. It was a closed system, closed to any internal initiative, and closed in the sense that it denied education to those who wanted it. Budgetary funds and resources were unequally distributed. Curricula were developed by a few 'expert' non-Namibians and therefore irrelevant to our society. Education was teacher-centred and examination-driven, and it lacked the development of skills, values and attitudes.

At the World Conference on *Education for All* in Jomtien, Thailand, in March 1990, Namibia was a signatory to the *World Declaration on Education for All and a Framework for Action,* a declaration of support to make education available to everyone on this planet. After this, the policy document for Namibian educational reform: *Toward Education for All – A Development*

Brief for Education, Culture and Training was developed to portray the intentions of the World Declaration as well as article 20 of the Namibian Constitution.

> The goal [after 21 March 1990] was to establish a national, unified system of education and training and to promote unity in diversity in the sphere of culture. The first five years immediately following the attainment of political freedom could essentially be characterised as a time of policy identification and formulation (Mutorwa, in Sguazzin and Van Graan 1999:11).

Scrutinising the key criteria for educational reform in Namibia as discussed earlier in this study, one wonders what the picture looks like after 12 years of the reform? A report on the achievements of Namibia in education over the past decade was done through the *Report of the Presidential Commission on Education, Culture and Training* (Government of the Republic of Namibia 1999). The Commission was impressed by all that had been achieved by a "... unified and thriving education system, full of dedicated and innovative educators..." (*ibid.*:17). Following are extracts of the report to illustrate the progression and shortcomings of the intended reform criteria:

Learner-centred education:

> [A] completely new curriculum, from grade 1 to grade 12, ... was achieved by 1998, under the guidance of the National Institute for Educational Development (NIED). Namibia's learner-centred curriculum is widely admired and acknowledged even beyond our borders (page 18). The process of change towards a learner-centred approach is a slow one, and much remains to be done (page 104).

Access, Equity, Quality, Democracy:

> Although Namibia has made commendable progress in improving access to basic education, the same cannot be said of equity and quality, which are closely linked to disadvantaged groups (page 23). ... teachers are not being supplied with the resources or support to provide quality education (page 96). ... teaching of the entry class is given to the least qualified teacher (page 100). Many teachers are still not competent enough to teach through the medium of English (page 110). Many teachers feel inadequate in mathematics education and are unable to give the children the skills that are needed to succeed in upper primary school and at secondary level (page 112). The school curriculum with its focus on democracy provides ample opportunity for teachers to include multicultural issues in their teaching (page 131).

Lifelong Learning:

> [C]hange on a global scale is now so fast that it is widely recognised that school is only the beginning of a lifelong educational journey (page 11). Moreover, schools do best when they are part of a learning environment, a culture of learning, when the teachers are growing intellectually and keeping up to date as lifelong learners, where parents and guardians take an interest in their children's learning, and themselves set an example as adult learners (page 30).

Training:

> A new University and Polytechnic have been created, two new Colleges of Education built and opened, while provision for vocastional *[sic]* training has also been somewhat increased. Massive efforts have been undertaken to provide in-service training for serving teachers. Almost uniquely on the African continent, adult education has been emphasised, giving adults and youths opportunities to catch up on lost opportunities through the National Literacy Programme and the Namibian College of Open Learning (page 21).

Culture:

> Whereas previously arts and culture were misused as a means of emphasising differences, Namibians nowadays can take pride and pleasure in many forms of expression that are being developed to establish Namibian identity and contribute to all aspects of personal and national growth (page 21-22). There is another aspect to culture in schools which is that many schools are now multi-cultural in their make-up ... However, the composition of most staff rooms is still monocultural and change in this area is slow (page 210).

The interviews done during the survey also delivered some valuable information on the strengths of the reform process (see Appendices D & E). A very strong feature is that there is a clear vision for education in Namibia. As Namibians, we have our own education system. It may not be perfect, but Namibians are involved, capacity is being built and insights are being gained. Localisation happens from inside. The entire country was involved in the whole process, with wide participation. National aspirations and expectations as well as local needs could be worked into the curriculum. Another strength was the wide consultation during the whole process - donors and advisors encapsulated our principles. A further strength was the willingness of our people to change. People shared experiences with one another and they could learn more about each other's backgrounds and cultures (pollination). We are a small system, easy to handle; thus we could focus on a grade at a time. The commitment from the Ministry of Education was recognisable, financing training and delivering the first sets of textbooks for each grade and for each child in the country. Transformation had a great impact on teacher development through involvement in syllabus development, materials production and training.

Naturally there are also the weaknesses or obstacles for successful implementation. Change brings discomfort and insecurity and there was resistance from some individuals to change, they did not understand the reason or the need to change. There was no time for individuals and more public relations work could have been done for the transition. The unequal level of provision for the different schools was another problem. The system was not fully congruent and not always supporting, and it did not fully respond to financial and personnel needs. Some bureaucrats in

Government offices did not change. Cascade training proved to be less successful - much of the original information went lost and regional trainers applied their own interpretations of certain concepts. The relative short time and massive scale of deliverance placed much pressure on the organisers.

Some issues could be seen as both strengths and weaknesses. Fast changes demanded flexibility and fluidness, and the transformation was not too rigid for change. We were left to explore and things consistent with the education system could be left to develop. As the landscape unfolded, we could set the parameters, for example the Education Act. People who saw the opportunities came forward and strong leaders emerged; it made some people more professional in their approach. On the other hand, people who could not cope left the system or became inefficient.

A decade of reform: What a lot of positive milestones have been achieved! In the midst of change, understaffed (and underpaid), pressurised for time, developing curricula without the guiding policy documents in place, coping with a whole new world out there... I think the Namibians have done just well with education thus far.

The way ahead...
Will teachers change their attitude, their resistance towards the new system?
Will they take up the responsibility to give quality education to our next generation in order to be a nation of excellence?
Will they set the example towards a learning community, so they can stand out as not only the knowledgeable ones, but as the wise ones?
Will they be a fair and just authority, making learning a joyful pleasure?
This study will not be complete without a clear picture of the learners who are at the centre of Namibian education.

5. THE LEARNERS

> To be able to meet the challenges of the 21st century we cannot take the approach of "business as usual" or "more of the same". We cannot continue to tread the well-worn paths, but we will have to risk imaginative innovation, otherwise we will fail those we are duty-bound to serve, namely the next generations (Swarts, in Avenstrup 1997:7).

Who are the 'next generations'? They are the 'primary partners' in education, the ones in the centre. They are the 'subjects, not objects'; who share responsibility for their learning and conduct (MEC 1993:176). They are also the ones who should have access to quality teaching in a

democratic learning environment where they are treated as equals. As for the Lower Primary phase there are plus minus 240 000 learners in 1000 schools, with an average of 33,8 learners per teacher. (Statistics are taken from the *EMIS Report,* MBESC 2001b). The *Report of the Presidential Commission on Education, Culture and Training* states:

> Access to schooling has grown, both at primary and secondary level. The total number of learners in schools has ...an annual growth rate of 2,5 per cent and an overall growth of 30 per cent. 50,6 per cent of learners are girls. About 90 per cent of school-age children (aged 6-16) are in school. The growth in the numbers of learners has been especially impressive in the northern regions. Enrolment increased by nearly 50 per cent over the decade...The repetition rate has also been considerably reduced. In 1991, half of the learners in grade 1 were repeating the grade. However, by 1997 over 80 per cent of learners were being promoted from grade 1 to grade 2 ...(Government of the Republic of Namibia 1999:18).

The requirements for promotion for the Lower Primary phase in Namibia have been discussed earlier. The *Presidential Commission* contends: "There is much concern about Government policy on 'automatic' promotion. This is concentrated in two issues: a) the promotion of learners who have not thoroughly mastered the work of their previous grade... b) the prohibition of repetition of grades 10 and 12" (Government of the Republic of Namibia 1999). In the survey we found that only 2 out of 17 members of the Lower Primary Curriculum Panel understood the requirements for promotion very well. Under normal circumstances, repeating a grade for a learner with learning problems would give such a learner the necessary foundation to carry on through the phase without further difficulties, provided that the learner receives compensatory teaching and support (MBESC 1996). Repetition in the same phase would thus be unnecessary.

The Namibian curriculum operates in a colourful and diverse environment, which makes the reform process much more demanding but also a very interesting and enriching experience. Next I will discuss the educational environment in which the reform is situated.

6. THE LEARNING ENVIRONMENT

Education in Namibia operates under two Ministries (*Basic Education* and *Higher Education*), in seven educational regions (*Windhoek, Keetmanshoop, Khorixas, Ondangwa East, Ondangwa west, Rundu* and *Katima Mulilo),* and in 1,513 schools, of which 998 are primary schools (2001 statistics EMIS report) (MBESC 2001b:4, 10, 14, 20). Out of the plus-minus 240,000 Lower Primary learners, 23,600 attend afternoon classes and they thus have less school hours per day. Namibians speak 13 different languages (with a number of dialects of some of these), and although the Language Policy promotes it, only about 50% Lower Primary (grades 1-3) learners are being taught through Mother Tongue instruction. Only about 65% of Primary teachers have

passed grade 12 and about 76 % have formal teacher training (1998 statistics, EMIS report). Most of these under-qualified teachers teach in the Lower Primary phase (MBEC 1999b).

Focus groups who contributed towards the research of the *Presidential Commission* raised some issues as most important. They are the physical facilities at schools; the shortage of books, materials, stationery, equipment and transport; automatic promotion; learner/teacher ratio; the financing and management of education; inequality; in-service training of teachers; language policy; school discipline; and the school calendar (Government of the Republic of Namibia 1999:96).

During policy making the *Ministry of Education and Culture* realised the terrible conditions of mainly rural schools, and has taken measures through a *Rural Physical Facilities Improvement Initiative,* with the involvement of local communities, to build classrooms, teachers' houses and ablution facilities."Many primary school classes ... are overcrowded and lack basic text books and classroom equipment. Many rural schools are dilapidated. Many are constructed from rudimentary materials or, at best, are corrugated iron sheds. Although both teachers and students try to ignore these conditions, learning suffers" (MEC 1993:173, 174).

Much had been achieved in the upliftment of the learning environment and about 30% of our recurrent budget is being spent on education. However, 1998 statistics from the *EMIS Report* (MBEC 1999b) and the *Presidential Commission Report* (Government of the Republic of Namibia 1999) indeed show the challenges that lie ahead in the strive towards access, equity, quality and democracy for all (rounded numbers):
70% of classrooms are permanent structures,
65% of schools had water supply,
60% of schools had toilets,
30% of schools had telephones,
35% of schools had electricity.

A few more issues that hamper education in Namibia are:
The *HIV/AIDS pandemic* has its effect on teachers and learners alike. Infected teachers tend to lose interest in in-service developments and are more concerned with their health. Learners who are infected or affected are being avoided and ridiculed, especially those orphaned through AIDS.

Gender equality: Since Mathematics is a compulsory subject throughout Basic Education and half of the school population are girls, they also benefit from being trained or educated in numeracy. However, Lower Primary education is still experienced as "inferior" or "lower" and given to the un-/under-qualified "memes" (mothers/older women) who, in some cultures, are ranked lower in social status.

Culture: Some parents, especially in urban areas, enroll their children in English medium schools to be of a higher societal class. Apart from the learning process that suffers, it delivers its own set of problems, e.g. poor communication, a feeling of superiority by some groups, prejudice, teachers who cannot cope in a multi-cultural setting, and many more. Our guiding policy states: "To enrich our national culture requires that we all take pride in our diversity" (MEC 1993:51).

Marginalised groups: " Educationally Marginalised Children are children, who for one or other reason, have difficulty in getting access to basic education" (Government of the Republic of Namibia 1999:127). The following children are included: children of farm workers; children in remote rural areas, e.g. San and Ovahimba; street children; children in squatter/resettlement camps; children with physical or mental impairment; over-aged children; the extremely poor; working children; orphans; refugee children; teenage mothers.

In January 1997 the Permanent Secretary: Ministry of Basic Education and Culture, Ms L Katoma quoted from a summary of the report of the *International Commission on Education for the Twenty-First Century*, entitled: "Learning: The Treasure Within":

> Building on the four pillars that constitute the foundation of education – learning to be, learning to know, learning to do and learning to live together – all societies move towards a necessary Utopia, in which none of the talents hidden like buried treasure in every person are left untapped (Katoma, in Avenstrup 1997:16, 17).

She further remarked that a major challenge for the next century would be to provide skills and knowledge for life. Since there are so many facts that no single person could memorise them all, we need to know how to find, interpret and analyse facts. "How do we teach our young African generation these skills, especially if we do not have these skills ourselves?" (*ibid.*).

7. CONCLUSION

Mathematics is part of everyday life and a good result in Mathematics is a prerequisite to almost any study course at tertiary level. And yet the *Presidential Commission* remarks that much attention was given to training primary teachers in language skills, but much less attention has been directed to numeracy training. It says further that many teachers feel inadequate in

Mathematics education and are unable to give the children the skills that are needed to succeed in Upper Primary and Secondary school level. "Unless the foundations are secured, it will be extremely difficult to build mathematical and scientific success at secondary level" (Government of the Republic of Namibia 1999:112). This was exactly the outcome of the survey. Teachers, Teacher Educators and Advisory Teachers all feel that they do not have enough wind beneath their wings regarding Mathematics on the foundation level. An in-depth revision of the Mathematics programme needs to be done and follow-up teacher development workshops will need to be conducted countrywide.

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9. APPENDICES

APPENDIX A:

QUESTIONNAIRE: LOWER PRIMARY MATHEMATICS PROGRAMME

(LP Panel members)

Region: _____ Rank: _____

1. **What are your perceptions (feelings) of the LP Maths syllabuses?**

_____

_____

_____

_____

2. **What are the strengths (good areas)?**

_____

_____

_____

_____

3. **What are the weaknesses (weak areas)?**

_____

_____

_____

_____

4. **How well do you know the content of the syllabuses from Gr. 1-4?**

Please mark the appropriate:

O very poor O poor O average O well O very well

Any comments:

_____

_____

5. **Do you think that Maths influences the pass/fail rate?** Yes / No

Why?

_____

_____

_____

_____

6. How well do the Maths syllabuses cater for:

Access____

Equity____

Quality____

Democracy____

7. What teaching strategies (methods) are currently used for teaching Maths?

8. How do you feel about the textbooks and/or Teachers Guides currently used?

9. Any other comments:

Thank you very much for your time and effort!

APPENDIX B:

QUESTIONNAIRE: LOWER PRIMARY MATHEMATICS PROGRAMME (Teachers)

Name of school: _____ Gr. _____

1. How do you feel about the content of the Maths syllabus that you teach?
   - Is it learner-centred? Why?

_____

_____

   - Is it gender and culture sensitive? Why?

_____

_____

2. What are the strengths (good areas)?

_____

_____

_____

_____

3. What are the weaknesses (weak areas)?

_____

_____

_____

_____

4. What teaching method(s) do you use in Maths?

_____

_____

5. What Teachers Guide and/or textbook(s) do you use?

_____

_____

6. How do you feel about these?

_____

_____

_____

_____

7. **How well do you know :**
   - **Your own grade Maths syllabus?** _____
   - **The syllabus of the previous grade?** _____
   - **The following grade?** _____

8. **Any other comments?**

_____

_____

_____

_____

APPENDIX C:

QUESTIONNAIRE: LOWER PRIMARY MATHEMATICS PROGRAMME (Learners)

Name of school: _____ **Gr.** _____

(Please draw a circle around the correct answer)

Have you been in this school since grade one? Yes / No

What is your main home Language? _____

1. Do you think Maths is an important subject? Yes / No

Why?_____

_____

_____

_____

_____

2. What do you like best about Maths?

_____

_____

_____

_____

_____

3. What don't you like about Maths?

_____

_____

_____

_____

_____

4. If you could change something about Maths, what would you change?

_____

_____

_____

_____

_____

_____

Thank you very much!

APPENDIX D

INTERVIEW WITH DR PATTI SWARTS

DATE: Friday 8 March 2002

The following are the main issues and personal viewpoints raised during the interview with Dr Patti Swarts, Director of the National Institute for Educational Development (NIED).

Background of the Namibian educational reform

The reform process began at Junior Secondary level. It was a conscious decision taken by the Minister, senior personnel and educational advisors for the following manageability reasons:

- fewer learners were involved
- learners at secondary level would be able to cope better with change to English as the medium of instruction
- Secondary school teachers were better trained.

  She thinks it was the right decision, because at that stage there was political pressure for change and the Ministry of Education was busy with their own restructuring. The Lower primary phase reform was the most successful, because it was done last, when both Government and Education Ministries were in place.

  The supervising bodies for the reform process were:
- Junior Secondary phase: A Technical Committee on Curriculum Development supervised by Minister Angula himself. Implementation happened in 1991-1993 for grades 8-10 respectively.
- Upper Primary phase: The Curriculum Implementation Programme.
- Lower Primary phase: The Lower Primary Task Force, supervised by Mr Alfred Ilukena.

The statement of Minister Angula: *Change for Continuity* formed the rationale, and National Integration of Education and Culture was the framework for the reform process

At a conference that was held in Swakopmund in 1993 it was decided that grades 11 and 12 would be offered as a unified course under Cambridge. The implementation happened in 1994 and 1995.

The Upper Primary reform was supported by the Florida State University Project. It was a longer process, because it was done subject by subject, starting with English and Mathematics. At that time grade 4 was still part of the Upper Primary school phase.

In 1995 the development of the Lower Primary curriculum began. Syllabuses were developed within the Ministry itself under supervision of the Lower Primary Task Force. There was skepticism about the appointment of Mr Ilukena as the head of the Task force, because he had no experience in the Lower Primary field, but he was an expertise in systems level organisation and in social relations.

What are the strengths?

- As Namibians, we have our own education system. It may not be perfect, but Namibians are involved, capacity is being built and insights are being gained.
- Donors and Advisors encapsulate our principles.
- Localisation happens from inside.
- There is a clear vision for education.
- The willingness of people to change.
- The wide consultation during the whole process.
- We are a small system, easy to handle.

What are the weaknesses?

- Resistance to change from some individuals. They did not understand the reason or the need to change.
- The levels of provision for different schools.
- More public relations work could be done for the transition. There was no time for individuals.
- The system is not fully congruent and not always supporting. It does not fully respond to financial and personnel needs.
- Some bureaucrats in Government offices did not change.
- There are still some unclarified things.

The following two points can be seen as both **strengths and weaknesses**:

- Fast changes demanded flexibility and fluidness, and the transformation was not too rigid for changes. We were left to explore and things consistent with the education system left to develop. As the landscape unfolds, we can now set the parameters (For example the Education Act).

- Change brings discomfort and insecurity. People who see the opportunities come forward and strong leaders emerge. It makes people more professional in their approach. On the other hand, people who cannot cope leave the system or become inefficient.

What are the implications for NIED?

NIED was targeted to spearhead the reform. It was a visionary decision by Minister Angula, whose commitment and belief in the new education system were portrayed by support opportunities and political goodwill.

What are your personal views or feelings of the reform?

She has grown tremendously. It was tough and she had to work long hours, but she feels fortunate to be part of the process and to experience a leading role in decision-making. This also implies a great responsibility, because learners are the clienteles. Each one carries their own baggage and we must be cognizant of own personal views and opinions, not to act against the interest of the learners. One should have strong principles.
The reform is exciting and challenging. It is dynamic and never static. One could not predict or plan exactly what could happen, but take a leap and hope for the best.
An old Chinese proverb says (when they want to curse you):

May you live through exciting times!

APPENDIX E

INTERVIEW WITH DR JAN ALBERTS AND MS SUSAN ALBERTS

DATE: Friday 8 March 2002

The following are the main issues and personal viewpoints raised during the interview with Dr Jan Alberts, former Chief Education Officer: Curriculum Development of the National Institute for Educational Development (NIED), and with Susan Alberts, Education Officer: Lower Primary Curriculum Development, NIED.

Background of the Namibian Lower Primary reform

The reform implementation of the Upper Primary school phase (grades 4-7) started in 1993 with English, followed by Mathematics in 1994, Science in 1995 and Social Studies in 1996. In 1996 the reform implementation of the Lower Primary school phase (grades 1-4) started off with grade one, followed by grades 2, 3 and 4 in consecutive years. The Lower Primary Task Force, assisted by several Projects e.g. BES and ELTDP, coordinated the training and implementation. Working groups did the planning and training and reported to the Task Force.

What are the strengths?

- Relevance: The entire country was involved in the whole process, with wide participation. National aspirations and expectations as well as local needs could be worked into the curriculum.
- People shared experiences with one another and they could learn more about each other's backgrounds and cultures (pollination).
- Commitment from the Ministry of Education, financing training and delivering the first sets of textbooks for each grade and for each child in the country.
- We could focus on a grade at a time.
- Transformation had a great impact on teacher development through involvement in syllabus development, materials production and training.

What are the weaknesses?

- Cascade training: Much of the original information went lost and regional trainers applied their own interpretations of certain concepts.

- The relative short time and massive scale of deliverance placed much pressure on the organisers.
- Attitudinal problems: some teachers did not want to change. This was an obstacle for successful implementation.

What were the implications for NIED?

It brought the Curriculum Division at NIED in direct contact with the entire country. Excellent coordination and support came from NIED management, the Deputy Directors of the educational regions, the Lower Primary Task Force, the Examination Board who had to evaluate all syllabuses and processes, and also the publishers who had to submit and print suitable materials in time.

Twelve typists worked very hard to deliver all the syllabuses in 13 languages (grades 1-3).

The production unit had the great task of copying, counting, packing and sending materials to the respective training venues.

What are your personal views or feelings of the reform?

For both interviewees the reform was a personal enriching experience. It was very challenging to deliver such a huge task under great pressure with only a core staff and limited resources.

THE EPISTEMOLOGICAL BASES OF BEHAVIOURISM AND CONSTRUCTIVISM

THE EPISTEMOLOGICAL BASES OF BEHAVIOURISM AND CONSTRUCTIVISM: A CRITICAL DISCUSSION

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THE EPISTEMOLOGICAL BASES OF BEHAVIOURISM AND CONSTRUCTIVISM: A CRITICAL DISCUSSION

ABSTRACT

This critical discussion aims to explore the prospects and underlying principles of the epistemologies of two opposing paradigms of education: Behaviourism and Constructivism. I have critically examined and compared the theoretical aspects that shape and inform the model of instruction and the systemic implications of the learning process. The purpose was to compare both learning theories and to draw a conclusion of which the better epistemology is for the teaching and learning process.

INTRODUCTION

> [P]hilosophy begins in wonder, in a kind of puzzlement about things. Nearly all human beings wish to comprehend the world they live in, a world that includes the individual as well as other persons, and most people construct hypotheses of varying degrees of sophistication to help them make sense of that world (Encyclopaedia Britannica 1992:466).

Educationalists currently find themselves in the midst of a major paradigm shift. Teachers are expected to be the 'change agents' in this transformation process and they play a major role in reforming the curriculum. They are, however, the greatest obstacles in the process, because of their adherence to outdated modes of teaching (Prawat 1992). Most teachers have been taught and trained in the procedural manner of knowledge transmission at the expense of conceptual understanding, and this is the learning theory that they have adopted and feel safe to practice. Thus, what teachers need now is theoretical understanding of the key principles of the old and the new epistemologies of Behaviourism and Constructivism in order to bring about change in education. Anderson explains it as follows:

> [T]heories are not the exclusive property of theorists. All teachers need theories if they are to negotiate the demands of teaching and be effective in their classroom on a daily basis...In essence, theories and models enable teachers to make sense of and to respond rationally to classroom events (Anderson 1995:90-91).

I will begin my discussion by shortly examining *Realism, Materialism, Empiricism* and *Positivism* as philosophical traditions underpinning Behaviourism, and proceed to discuss shortly the various paradigms of Constructivism, viz. *Radical, Social* and *Critical* Constructivism. I will then explore and compare the Behaviourist and Constructivist perspectives of knowledge, teaching and learning, and of the curriculum. I will incorporate various philosophical stances from a number of philosophers and researchers in the modern and post-modern worldviews. I

will conclude in comparing the strengths and weaknesses of both learning theories in order to make an informed decision on which the better epistemology is.

BEHAVIOURISM AND ITS EMPIRICAL ROOTS

Behaviourism as a scientific theory of education has its origin in the dominant worldview of *Modernism*, which has started about four centuries ago with the *Age of Enlightenment*. It has grown through strong and widely held theories and doctrines, given validity by science. Great scientists such as Newton and Darwin, and numerous famous philosophers and researchers have influenced and shaped it. Van Harmelen (1995:51) defines Behaviourism as "...a network of theoretical perspectives held together by the common belief that personal experience is understood and exhibited as behaviour or actions that result from our interaction with our physical and social environment". The most important of these perspectives for education are *Realism, Materialism, Empiricism and Positivism.*

Realism is based on "the common-sense belief that a real world exists regardless of whether we take interest in it or even notice it... We come into the world as discoverers who build copies or replicas of reality into our minds" and "something is true... only if it accurately corresponds to an independent, objective reality" (Bodner 1986:874). It is committed to two basic principles: that some of the objects perceived are *public* and others are *mind-independent.* Ozman and Craver (1986) see a connectedness between Realism and Behaviourism in the latter's study of particular observable facts, the rejection of mind, consciousness or soul as the agent of behaviour, and the search for processes and patterns of reality through which behaviour is shaped.

Materialism is a theory that the world consists entirely of matter and the energy inherent in it, or 'matter in motion'. It disregards any immaterial things such as the mind or inner person and explains them away as motions of material things. Thomas Hobbes (1588-1679) described biological natural life as 'mechanistic' and compared the artificial life of a machine to that of an organised society (Ozman and Craver 1986). Behaviourism also views human beings as a material body with behaviour as motion. "The significant thing is to observe behavior (motion) of a body in an environment (supporting material conditions)" (Ozman and Craver 1986:167).

Behaviourism shares the Empiricist opinion of "... an orderly world governed by rules or laws according to which change conforms" (Van Harmelen 1995:53). *Empiricism* has its origin

mainly in the philosophical writings of John Locke and David Hume. Locke described the mind at birth as an 'empty slate', and that all knowledge derives from experience. Hume took this philosophy further in stating that the content of the mind is obtained through the data of the senses. The name *Empiricism* is derived from the Greek word *empeira,* which means *experience.* It implies that knowledge is acquired through sensory experiences and through inner feelings or 'inner sense'. These are combined through *association* into meaningful concepts (Aspin 1995).

Another theoretical viewpoint that is related to Empiricism is *Positivism.* Auguste Comte, a French philosopher, was the initiator of Positivism. His main objective was to reform society by applying scientific rules to social policy. The two basic affirmations of Positivism are "... that all knowledge regarding matters of fact is based upon the 'positive' data of experience, and... that beyond the realm of fact is that of pure logic and pure mathematics" (Encyclopaedia Britannica 1992:630). Contemporary or *Logical Positivism* is essentially the doctrine of the Vienna Circle, a group of European philosophers, mathematicians and scientists who employed formidable tools of logical analysis to express scientific knowledge "...in propositional forms that were logically sound and philosophically meaningful" (Aspin 1995:27). Their main focus was thus on 'the logic of propositions' and 'the principle of verification'. It means that no statement should be taken as truthful unless it can be verified empirically. Constructivism dawned with a radical paradigm shift in its epistemological views.

EPISTEMOLOGICAL POSITIONS IN CONSTRUCTIVISM

The antithesis for Behaviourism came in an outcry for acknowledging the learner as a person with a mind, who is responsible for constructing her or his own perception of the world through social interaction with co-learners. Thus Constructivism was born with the *Radical Constructivist* emphasis on the individual's construction of knowledge, the *Social Constructivist* emphasis on culture and language in the social construction of knowledge, and the *Critical Constructivist* acknowledgement of both these epistemologies. Constructivism is a relatively 'young' theory of knowledge, which has its roots in the post-modern worldview. It is only in the last part of the twentieth century that voices began to raise in favour of a transformation in education from the strongly held perspectives of Behaviourism.

> Social Constructionism ... begins with radical doubt in the taken-for-granted world – whether in the sciences or daily life – and in a specialized way acts as a form of social criticism. Constructionism asks one to suspend belief that commonly accepted categories or understandings receive their warrant through observation. Thus, it invites one to challenge the objective basis of conventional knowledge (Gergen 1985:267).

Lev Vygotsky is considered a leader in the field of *Social Constructivism.* Vygotsky's theories are about language and thought, and their social mediation by community and culture. Vanderstraeten and Biesta (2002) supports Vygotsky's theory, saying we live in a 'common world' and that social interaction enables (and forces) everyone involved in it to pay attention to the contribution made by the other participants.

Jean Piaget and Ernst von Glasersfeld are pioneers of *Radical Constructivism.* Von Glasersfeld bases his arguments on two principles. The first is that knowledge is something that is personally constructed by individuals in an active way, and the second is that knowledge is subjective: a cognitive activity of making sense of experiences (Ernest 1993). Learning is the product of self-organisation and the reflection on personal experience (Taylor and Campbell-Williams 1993). Piaget was concerned about the mental life of the child and his major theory proposes that cognitive development move in four development stages: the *sensory-motor, pre-operational, concrete-operational* and *formal-operational* stages. He holds that knowledge is constructed through the organisation of experiences in terms of pre-existing mental structures.

Critical Constructivism adopts both the *Radical* and *Social* Constructivist perspectives. The key principles are based on Jurgen Habermas' theories for pedagogical reform. The first theory identifies the subjective and dynamic nature of cognition; the second that knowing and understanding are 'intersubjectively' grounded in the use of language; and the third theory states that knowing constitutes a process of critical reflection. Therefore *Critical Constructivism* intends a classroom community of open and critical discourse (Taylor and Campbell-Williams 1993). Following is a critical analysis of the theories of knowledge within both paradigms.

THE THEORIES OF KNOWLEDGE THAT UNDERPIN THE PRACTICES OF BEHAVIOURISM AND CONSTRUCTIVISM

In recent years there has been a growing need in the western society for change from the mechanistic, prescriptive models of behaviour modification to models of managing own mind, own will, own thinking and own creativity. The outdated method of 'only one right way to gain knowledge' does not satisfy the needs for the advancement and change in technology and the contemporary quest for information. One of the key principles of Behaviourism asserts that knowledge, which exists in the real world external to the human mind, is discovered through sense experience and reason, and can only be advanced through observation and experiment. Through the repetition of these, one can gain evidence of the 'laws and rules' that govern events

and so define objective, universal 'truth' statements of precise facts. It further holds that knowledge can be broken down into smaller parts and can be acquired through 'high order' or 'low order' cognitive skills (Taylor and Campbell-Williams 1993, Van Harmelen Core Text 2, Aspin 1995, Ozman and Craver 1986). Gergen (1985:266) critiques this stance by arguing that:

> What we take to be experience of the world does not in itself dictate the terms by which the world is understood. What we take to be knowledge of the world is not a product of induction, or of the building and testing of general hypotheses.

The concepts of 'truth' and 'objectivity' are doubted, because the adjudicator cannot take a stand outside the statement. The mere fact that senses are involved in the acquisition of knowledge implies subjectivity. Constructivism challenges this key principle of behavioural epistemology by arguing that knowledge is a dynamic process, which is both constructed in the mind and continually tested as the learner gains greater conceptual understanding and deeper insights into the world. It implies the integration of knowledge, concepts, skills, values and attitudes, which are all equally important in the learning process. It emphasises the basic role of prior knowledge, which every individual brings into the learning situation, and which forms the basis for problem solving. One can come to knowledge in many different ways and at a number of levels (Van Harmelen 1999, Prawat 1992).

Behaviourists further believe that knowledge is explained through the principle of 'cause and effect', holding the perception that behaviour is the result of stimuli from the environment which cause a chain of reflexes. "This notion of causality is problematic for any theory that refutes the possibility of choice and free will" (Van Harmelen 1995:63). For Behaviourists mentalistic concepts of mind and consciousness are rejected and the mind viewed as a 'black box'; "... we can accurately judge what goes in (stimulus) and what comes out (response)" (Bodner 1986:874). Constructivists argue that emotions and mental acts such as judging, believing and deciding cannot be reduced to a set of physicalistic descriptions; and that the uncertainty is rather in the relationship between our mental structures and the real world (Aspin 1995). The Behaviourist 'robotisation' of humanity is further evident in their view of teaching and learning.

IMPOSED TEACHING OR NEGOTIATED LEARNING?

> Open discourse reveals the heart of what it means to teach and to learn
> (Taylor and Campbell-Williams 1993:17).

The empirical philosophy behind Behaviourism has a strong argument for the scientific principles of behavioural engineering. Ivan Pavlov pioneered the way with his conditioning theory of reflex behaviour. He was followed first by Watson who claimed that the environment was the shaper of behaviour and "...if he could control a child's environment he could then engineer that child into any kind of person desired" (Ozman and Craver 1986:167). Skinner proceeded with techniques for the implementation of behavioural engineering; the replacement of erratic programmed behaviour with systematic and meaningful experiences (conditioning) that would bring about the desired (permanent) changes in behaviour. This mentality of manipulation and machine-like functioning is totally rejected by many critics as belittling and limiting humanity (Cornbleth1987, Ozman and Craver 1986).

Behaviourism advocates teaching as the transmission of unchallenged 'true' facts by the teacher as the expert source of knowledge, to the individual child as passive recipient. This means that the teaching/learning situation is autocratic: the teacher is in control and decides on the learning content. To motivate students to progress it is essential for positive reinforcement or rewards. Tamir (1995), on the other hand, describes the learning process as involving all kinds of input, including (individual) discovery and (social) reception inputs. The role of the teacher, he holds, is to help learners process these inputs and construct their own knowledge, as well as appreciate and apply it. Van Harmelen (Core Text 1) sees the role of the teacher as transmitter of information, facilitator, scaffolder and co-learner. Bodner (1986:876) explains the teacher's role as 'transmitter' as such: *Social knowledge* is best taught by direct instruction, e.g. days of the week, whereas *physical* and *logico-mathematical knowledge* "...cannot be transferred intact from the mind of the teacher to the mind of the learner". In Parson's opinion:

> [K]nowledge is cognitively constructed through the active engagement of the learner in the learning process, and socially constructed through collaborative reflection on experience. Only through encouraging this process do we achieve 'deep learning'; learning with understanding; learning that will enable students to move knowledge beyond the level of recall; learning that both demands and encourages higher cognitive reasoning and problem-solving (Parsons 2001:14).

The scientific approach to education is a central target of criticism and has been exposed as a theory of myths. Much has been written about myths in education (e.g. Prawat 1992, Van Harmelen 1995 and Cornbleth 1987): beliefs about teaching and learning that had grown into taken-for-granted 'truths'. Behaviourism holds that learning or knowing occurs through repetition and memorisation of facts in order to provide the 'right answer'. Cornbleth (1987) challenges this as a myth by arguing that learning of this sort is an inefficient means of information acquisition and does not necessarily involve knowledge comprehension, integration or application. The

second myth is that of 'stages (presumed abilities) and styles (modes of learning)'. This is portrayed by the belief that students progress through stages of cognitive development that are distinct from maturation and acquire knowledge through 'high order' or 'low order' cognitive skills. It justifies ability grouping and 'labelling' learners (Cornbleth 1987). 'Thinking Skills' is another myth described by Van Harmelen (1995:53, 63) as generic skills that are composed of discrete hierarchical steps acquired through a linear process. In reality, she argues, thinking is recursive and "...our thinking and the skills and competencies within thinking are content and context-specific". Prawat (1992:364,378) equates learners' thinking with sense making. He says thinking is 'highly contextualised' and subject-specific within a specific setting: "Ideas, being more substantive by nature, may be a more important resource for promoting thought than thinking skills per se".

The outcomes of Constructivist education, according to Spady and Marshall (1991) aim at developing (1) collaborative contributors/workers, (2) innovative producers, (3) self-directed learners/achievers, (4) complex/perceptive thinkers, (5) community contributors, (6) involved citizens and (7) adaptable problem solvers.

CURRICULUM

What is at the heart of the post-modern curriculum?

> At the centre of a curriculum informed by an emancipatory interest is a counter-hegemonic concern for liberating teachers and students from the disempowering constraints of the technical ideology (Taylor and Campbell-Williams 1993:13).

Van Harmelen (1995:51) defines curriculum as "... an expression of what is perceived as worthwhile and acceptable with regard to knowledge, its acquisition and pedagogy". One of the principles of Behaviourist education is *scientific management* with *measurement* and *task analysis* as key features. Franklin Bobbitt adopted the task analysis approach with "...precise specification of 'particularized' objectives derived from activity analysis as the central task of curriculum construction" (Cornbleth 1987:199). Ralph Tyler followed in his footsteps with his 'production model' of behavioural objectives. Tyler holds that:

> The most useful form for stating objectives is to express them in terms which identify both the kind of behaviour to be developed in the student and the content or area of life in which this behaviour is to operate (Stenhouse 1981:54).

Tyler's aim in bringing about changes in students' patterns of behaviour was strengthened by Benjamin Bloom, with his publication of a *Taxonomy of Educational Objectives,* a 'recipe' or

exhaustive, hierarchical list of intended learning outcomes stated as behaviours to be developed. Bloom's taxonomy articulated Skinner's ideas of education as a 'building' process, which is arranged in systematic steps from the particular to the complex, into a teaching method (Van Harmelen 1995). The curriculum was thus developed in a precise schedule with a linear progression and accurate measurement; evaluation is summative and norm-referenced. Skills and values are less important and not included. Grundy, as cited in Taylor and Campbell-Williams (1993:6), calls it a 'product-oriented curriculum' with predetermined content, through which behaviour and learning are strongly controlled by the teacher.

Prawat's (1992) counter argument for Tyler's curriculum model is an 'open-systems' view of curriculum with an 'interaction' or 'ideas-oriented' curriculum model. "According to this alternative perspective, teachers should discard the notion of curriculum as a 'course to be run' and think of it more as a network of important ideas to be explored" (Prawat 1992:382). From a Constructivist perspective the ideal curriculum will cater for human interaction between teacher and learners, meaning-making activities with supportive learning materials and problem solving. It will allow reflection and judgement as part of an overall personal development and improvement. The content will be flexible and dynamic, and it will be judged against social norms. Teachers will be interpreters of curriculum documents who actively participate in curriculum development (Taylor and Campbell-Williams 1993). Assessment of conceptual understanding will occur continuously and through a variety of assessment strategies. Assessment will serve to evaluate the teaching process and support the development of knowledge, skills, competencies, values and attitudes in both learners and teachers as co-learners. The curriculum will further support a thematic learner-centred approach to teaching, reflecting an awareness of gender, culture and context. Doll (1989) supports these views and suggests a heuristic 're-visioning' of an open-system curriculum:

> Here we will envision curriculum not as a linear trajectory nor as a course (with hurdles) to be run, but as a multifaceted matrix to be explored. In this matrix, places where one begins and ends are far less important than how well one explores the myriad connections, logical and personal, inherent to the matrix. In regard to daily lesson plans the focus would be not on closure but on flexibility for alternative yet productive pathways...that students would develop their own alternatives and insights (Doll 1989:251).

STRENGTHS AND WEAKNESSES

The greatest strength of Behaviourism lies in its dominance on the educational front. It is a convincing and comprehensive theory, systematically organised on macro and micro level in

easy-to-follow and ready-made 'recipes'. Assessment is objective and easy to apply, and standardised tests can be used repeatedly. The most important weaknesses in Behaviourism are portrayed in the view of knowledge as factual 'truth out there', to be discovered and demonstrated through certain behaviour (i.e. the verbatim memorisation through repetition in order to provide right answers in examinations). Knowledge is transmitted through 'teacher-talk'. There is no room for the development of skills, values and attitudes, and initiative and creativity are smothered. Learning content and learners are regarded fixed entities, and the only differentiation is observable in the pace of instruction and learning style. The curriculum is regarded a prescriptive, time-defined course to be delivered with predetermined objectives as fixed ends, and the outcome is an academically competent individual (Van Harmelen Core Text 2, Stenhouse 1981).

The strengths in Constructivism, on the other hand, lie in the interactive model of learning that starts with the learner's prior knowledge and concepts that make sense, and builds or constructs new understanding through learner-centred activities and shared experiences. The curriculum is regarded a network of interesting ideas to be explored. Peter Davson-Galle (1999:207) describes this "interactive, interest-engaging, student-brain-using" teaching of a better quality than "the greater quantity of a 'force-feeding' curriculum". There are, however, some weaknesses to consider in Constructivism. Teaching in a 'democratic' environment of interactive exchange of ideas and experiences can be time-consuming and result in less content covered than in the instructional method. Some misinterpretations of the Constructivist perspective can result in an understanding, for example, that activity equates learning. Allowing learners to structure their own learning demands extra effort and careful planning and management of the learning situation on the part of the teacher. Allowing learners to air their views and construct new understanding, teachers must always be alert that misconceptions may occur (Davson-Galle 1999).

CONCLUSION

There are different pedagogic approaches to what constitutes knowledge, for example to identify knowledge with information (knowing 'that'), versus the idea to identify knowledge with the process of thinking and understanding (knowing 'how').

> What we need to adopt...is an 'evolutionary epistemology', an approach that goes, as Richard Bernstein (1983) puts it, 'beyond objectivism and relativism' and enhances and facilitates discriminatory theory construction and comparison and so allows our own

> theories to receive application, modification and repair at every stage of our intellectual journey (Aspin 1995:46).

I have endeavoured to give as clear a picture as possible of the epistemological perspectives of both Behaviourism and Constructivism. I have realised that the vision of the world is changing, turning from classical science as permanence to a dynamic society of openness and diversity. Having considered the positive and the negative attributes of both theoretical perspectives, I am of the opinion that the better epistemology is that of Constructivism. The integrated approach to the curriculum caters for learners' perspective needs and allows learning beyond the school and classroom. It encourages initiative and creativity, judgement making and reflection on the learning process, and also to challenge knowledge and facts. It allows the learner to develop as a 'whole' person with knowledge, skills, values and attitudes in order to serve the community as a competent citizen.

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LITERATURE REVIEW: PROBLEM SOLVING AS A BASIS FOR CONCEPTUAL UNDERSTANDING OF MATHEMATICS IN THE LOWER PRIMARY PHASE

LITERATURE REVIEW
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INTRODUCTION

This is an investigation into the theories that underpin and inform mathematics teaching in the Lower Primary phase of the primary school in Namibia. The Namibian society requires the development of knowledge and understanding, skills and competencies, attitudes and values, which everyone must have to be able to function adequately in society on a social, economic and political level (MBESC 1996). We need to seek ways of enhancing mathematics teaching in Namibia if we want to live up to the expectations of our society. Cox and Lewis (2002:1) describe the importance of mathematics in everyday life as follows:

> Mathematics is a language we use to identify, describe and investigate the patterns of everyday living. It helps us to understand the events that have occurred and to predict and prepare for events to come so that we can more fully understand our world and more successfully live in it.

A Social Constructivist epistemology has been adopted for the Namibian education reform and the teaching approaches that form the foundation of Lower Primary education (regarding mathematics) are: learner-centred education, cross-curricular or thematic integration and the problem-based approach to mathematics. From this perspective I will investigate mathematics education in general, followed by the role of the teacher in the mathematics classroom. Problem solving as the basis of mathematics learning will be highlighted among the mathematical concepts of the Lower Primary curriculum. Learner autonomy and mathematical discussions or communication are some of the key features of the problem-based approach. The empirical dimension of the research will thus investigate whether the problem-based approach is being recognised as an ideal method of mathematics learning in Namibian Lower Primary classrooms, how it is being understood and applied by Lower Primary teachers, and the quality of learning that results from it. Figure 1 maps out the concepts and areas to be investigated.

Mathematicians and researchers across the globe have theorised and speculated about education reform movements. Mathematics reformation as part of it will be investigated next, and the perspectives and opinions of mathematicians and researchers looked into as a theoretical basis for the research study.

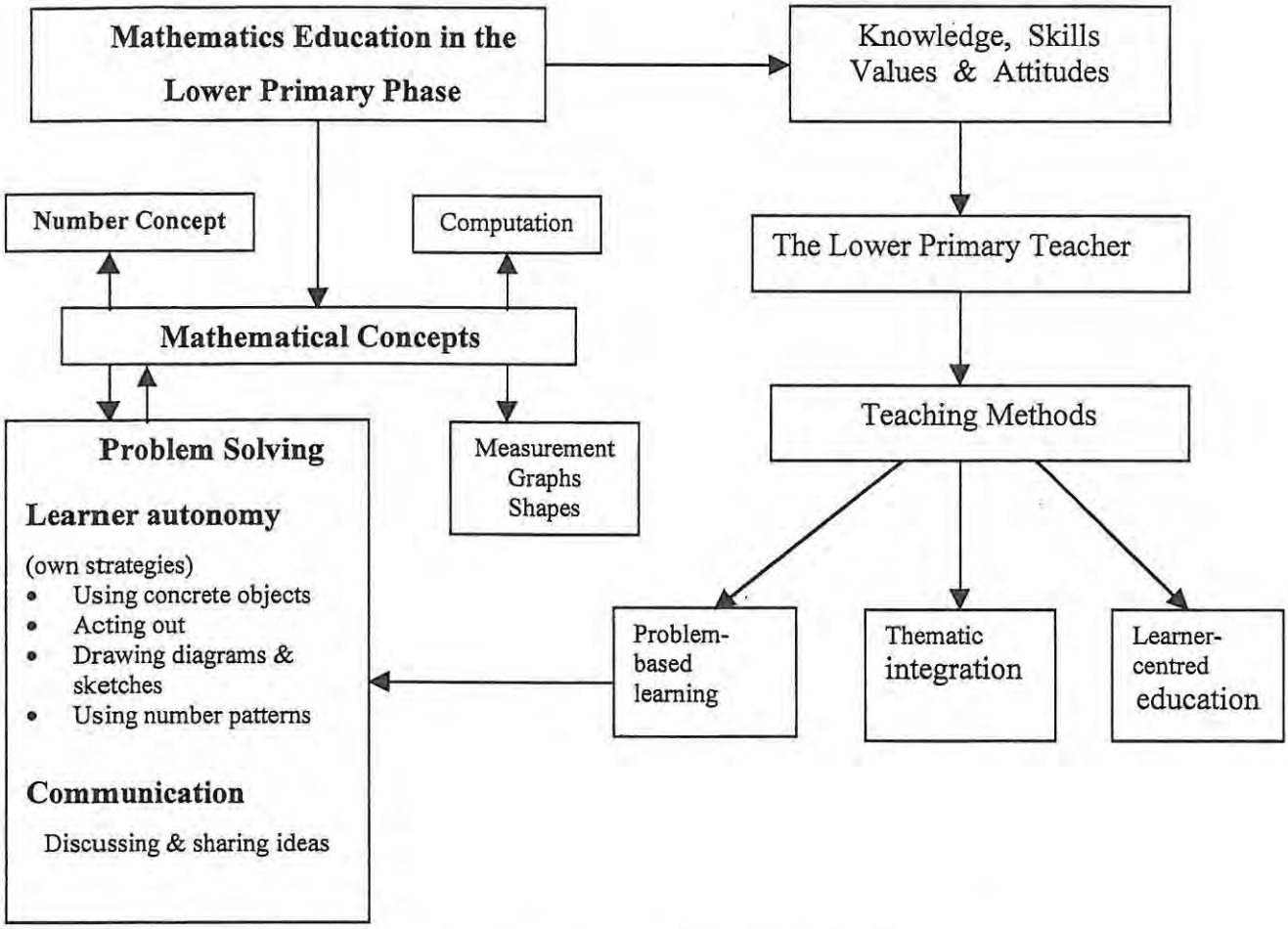

Figure 1: Concept map of the study.

MATHEMATICS EDUCATION

The Guiding Policy for the reform in Namibia: Toward Education for All (MEC 1993) assigns the highest priority to the four major goals for education and to those activities essential to reaching them: *access, equity, quality* and *democracy*. The specific aims to promote functional numeracy and mathematical thinking as a learning area are (MEC 1993:56):

- to develop positive attitudes toward mathematics;
- to assist learners in acquiring the basic number concepts and numerical notation;
- to help learners understand and master the basic mathematical concepts and operations;
- to help learners apply mathematics in everyday life.

The Broad Curriculum for Formal Basic Education in Namibia (MBESC 1996) promotes the development of *knowledge and understanding, skills and competencies, attitudes and values*, which everyone must have to be able to function adequately in society. It echoes the four major

goals and the aims as stated above. The aims are further broken down into more detailed *objectives* in the subject syllabuses. *Competencies* describe what a learner should be able to do as the outcome of teaching and learning. It distinguishes between two levels of competence: more detailed *Basic Competencies*, and *Life Skills Competencies*. The latter comprise investigating, interpreting, applying knowledge and skills, communicating, valuing and participating. The Broad Curriculum gives high priority to mathematics teaching, allocating teaching time for more than the equivalent of one school day per week: plus-minus 22% of school time in the Lower Primary phase, and 21% in the Upper Primary phase. It states further that, in the mathematical area of learning, learners should "...understand and master a variety of mathematical skills, knowledge, concepts and processes in order to investigate and interpret numerical and spatial relationships and patterns that exist in the world. It helps learners develop conciseness and logical and analytical thinking, and to apply them to other areas of learning and real life" (MBESC 1996:15).

There is much controversy about what is believed to be *good* mathematics education (what society requires from mathematics learning), and what really happens in classrooms. Lave, as cited in Lerman (2001:101) argues that mathematics itself should not be seen as an abstract task, but as "something deeply bound up in socially organised activities and systems of meaning within a community". To be effective, mathematics teaching should address the full range of learning outcomes: not only the facts, skills, conceptual structures and general strategies of mathematics, but also the learners' attitudes to and appreciation of the subject (Ernest 1997).

> Society determines that children should attend school for a certain period of their life. The social ... and cultural ... purpose of schooling differs across the world, based on political, economic and cultural determinants as well as... the inertia of systems with often many decades of history. [G]iven the age range covered by compulsory schooling, participants' identities are at their most formative, and children are particularly vulnerable to the regulating effects of social practices (Lerman 2001:99).

Reform movements all over the world aim for more than just structural knowledge when it comes to mathematics. The Portuguese *Innovative Movement* of curriculum development is related to the reflexive, purposeful use of knowledge and to learner autonomy. It intends to emphasise the integration of knowledge, skills and attitudes to content knowledge, where integration is the key idea. "The ultimate goal is to develop understanding and appreciation of the nature of mathematics, rather than 'enriching' the knowledge of facts and the training of procedures with some sort of rhetoric about it" (Abrantes 2001:135). In England and Wales *Using and Applying Mathematics* (UAM) was introduced and made mandatory in 1989 as part of

the *Mathematics National Curriculum*, for a greater focus on the process-based aspects of mathematics. The aims of UAM were the development of problem solving and investigational strategies; understanding of mathematical concepts and competence in techniques; the ability to apply mathematics to a range of contexts; and personal qualities such as independence, perseverance and co-operation (Millett 1998).

Mathematics reform movements do not always report success stories. Mathematics curriculum reform in Colombia, according to Agudelo-Valderamma (1996), does not contribute to the realisation of the full potential of the learners. The emphasis on the *Pure Mathematics Model* and the teaching of the subject as ruled-based calculations, disconnected from real situations, makes the subject useless to the learner. Mathematics education "should provide pupils with the opportunity to engage in work that leads to analysis and discussion of situations felt in the community, and develops into action" (Agudelo-Valderamma 1996:21). Coetzer (2001), evaluating *Outcomes-based Education* (OBE) in South Africa, expresses concerns about poor performance in mathematics and science (the worst compared to 12 other countries on the African continent). This is despite the fact that a sound content base, a prerequisite for critical thinking and problem solving, has been at the heart of OBE since the beginning of *Curriculum 2005.*

In Catalonia, Spain, mathematics education is faced with another problem. Rapid increasing immigration into Catalonia results in linguistic barriers. Not being able to converse mathematically goes further than barriers arising in simple, everyday communications. The educational administration provides language lessons for six months before learners join regular classes, but in the meanwhile lessons continue in the regular mathematics classes and learners already have a backlog when they join (Gorgorio and Planas 2001). India's *Operation Blackboard* aimed for quality improvement in elementary education through the child-centred approach. They laid down minimum criteria for primary schools and provided a set of minimum essential teaching and learning materials, which included a mathematics kit. The failure of this endeavour to improve quality teaching can be related to a few factors: the centralised, top-down approach that did not involve teachers in decision-making; inappropriate training in the application of the operation; the poor quality and inappropriate quantity of materials; and time span of delivery thereof (Dyer 1996).

In the United States of America (U.S.A.) there have been a number of 'pendulum swings' in their mathematical reform efforts (Burns 1998:1). She describes the *New Math* in the 1960's, the *Back-to-Basics* in the 1970's, followed by *Problem Solving* in the 1970's and then the *Principles and Standards* in the 1990's. Schoenfeld (2002), reporting on the *Principles and Standards* set by the *National Council of Teachers of Mathematics* (NCTM) as a new vision for mathematics education since 1989, discusses the potential for providing high quality mathematics instruction in the U.S.A. Their visions are equity, coherent curricula, teacher professionalism and the effective use of assessment and technology. Researching results from Pittsburgh, Pennsylvania, he reports that there is significant growth in 'strong implementation schools' (p 16). The average achievements of mathematical skills, concepts, and problem solving have increased, and racial differences in performance have diminished substantially. However, the *Third International Mathematics and Science Study* (TIMSS) report of 1996 pointed out that the results of the U.S.A. were among the lowest of the 38 participating countries (Mastrull 2002, Devlin 1998). This erupted in new controversies about pedagogical approaches to mathematics and in December 1997 the *California State Board of Education* endorsed the *Back-to-Basics Math Standards,* emphasising the fundamental arithmetical computation skills and rote memorisation (Colvin 1997).

Both Mastrull (2002) and Judson (1999) were intrigued by the success of the Japanese education system in producing students who excel in mathematics, and both made comparative studies with those of the U.S.A. programmes. Judson (1999:75), citing the TIMSS report, says that "...the current U.S.A. *Standards* are unfocused and ... a mile wide and an inch deep. In Japan, on the other hand, the achievements of students reflect the benefits of coherent goals and focused teaching practices". Mastrull (2002:3) confirms this as a contrast to the U.S.A. curriculum, which "...lacks focus and coherence and ...have lower expectations", and further: "The Japanese assume that learning is the product of effort, perseverance and self-discipline rather than of ability".

If mathematics education plays such an important role in society, who are its 'agents of change' or 'obstacles to change' (Prawat 1992)? They are the ones responsible for the development of the "identities of students as speakers and actors of mathematics in school classrooms" (Lerman 2001:98). In the next chapter I will discuss the role of the teacher in mathematics education.

THE MATHEMATICS TEACHER

The Namibian policy expects from its teachers to be both teachers and learners:

> What teachers do must be guided both by their knowledge of the concepts and skills to be mastered and by the experiences, interests and learning strategies of their students. Our challenge is to harness the curiosity of learners and excitement of learning rather than stifling them. To achieve that, teachers must be learners (MEC 1993:10).

Namibian education strives for quality. An important challenge in improving the quality of education is to ensure that teachers are well prepared for the major responsibilities they carry, and that they develop the expertise and skills that will enable them to stimulate learning. Therefore it is essential that teachers see themselves as contributors to nation building and not simply workers who carry information between curriculum experts and learners. Therefore supervision must be supportive and not punitive (MEC 1993). Teaching, it states on page 120, must be learner-centred and aim toward:

- an enlightened understanding of humankind, its culture, its traditions and its history;
- a methodology that promotes learning through understanding and practice directed towards the autonomous mastery of living conditions;
- a general reorientation of the organisation of school work with the view to fostering the acquisition of basic knowledge and skills by all pupils;
- continuous assessment of the learning process and its results;
- promoting and protecting the fundamental equality of all learners and equity in their access to, their work in, and their benefits from the learning environment; and
- introducing and encouraging classroom practices that reflect and reinforce both the values and practices of democracy.

Many researchers believe that teacher quality is by far the single most important determinant of learner performance. What the teacher knows and believes, and how the teacher acts, all influence the success of the learner (Pon 2001). Schoenfeld (2002) agrees and states four conditions necessary for providing high quality mathematics instruction: high quality curriculum; a stable, knowledgeable, and professional teaching community; high quality assessment that is aligned with curricular goals; and stability and mechanisms for the evolution of curricula, assessment, and professional development. Dyer (1996), arguing for higher entry requirements and better teacher education, suggests there is a positive correlation between length of training and quality of teachers.

If teachers are the 'change agents', what are the obstacles and difficulties relating to implementation of a new curriculum and the responses of teachers to change? Millett (1998) focuses on the nurturing role that the principal and school managers should adopt. They play a crucial role in bridging the needs of individual teachers and the provision of courses of action. If curriculum development is to progress it must engage with the beliefs and the practices of the teachers involved. In any mathematics reform one will find 'strong implementation' teachers practising the activities and procedures specific to the new curriculum, as well as 'weak implementers' who still teach in the traditional approaches (Schoenfeld 2002:16). One of the reasons could be a fear of teaching mathematics. It might be a fear of or reluctance to the subject itself, or feelings of frustration or boredom that they experienced with the way they were taught (Fisher 1995).

Schoenfeld (2002) says another reason could be that teachers are not treated as professionals or given the opportunity to develop their skills and understandings. Once they enter the field the vast majority have minimal opportunities for professional growth. Other than in nations such as Japan and China, teaching is a profession more in name than in reality. The *National Commission on Teaching and America's Future* reported in 1996: "Teaching is one of the most demanding and least understood or rewarded occupations in the United States" (Schoenfeld 2002:20). The *National Policy on Education* of 1986 in India had failed largely in its aim for qualitative improvement in elementary education, a move towards a child-centred approach to education. The main reason for the failure was a centralised top-down approach instead of involving teachers in decision-making. "To set up such dialogue would require ... to put the teachers at the centre of education practice, rather than on paper" (Dyer 1996:39). Godwin (2002) writes about the struggle that teachers in England and Wales experience for a lack of professional worth and public respect that resulted from post-war mass education. In an attempt to improve quality and standards in education the focus for professional development had been shifted from *professional competencies* to *national standards.* Reynolds (1999) criticises this action as unsuccessful, because the 'how' of practice and the personal qualities and values to be a successful teacher have been overlooked.

So, what are the mathematics teacher's responsibilities in (and outside) the classroom? "[T]eachers must always remember that they are the eyes and ears of society and that whatever they do, the difference between official hours and off hours is relative. They have to demonstrate

not only professional competencies and skills, but also social responsibilities as mirrors of society" (Ilukena 1998:25). Fisher (1995) agrees, saying because teachers are in a position of trust and responsibility, they are constantly being observed and judged. Hence, they are accountable for their own professional actions. Reflecting on their practice as a teacher can help in identifying weaknesses and recognising and building on strengths. Teachers will need to consider elements of their teaching in more detail to make sense of their work and to assess more clearly. Prawat (1992) also emphasises that transformative change will require a great deal of reflection on the part of the teacher, attending to their own conceptual change as much as for their learners.

Ernest (1997) argues that the teacher is the mediator between the corpus of mathematical knowledge and the learner, selecting and representing mathematical knowledge for them. The teacher should also monitor learners' progress, communicate feedback, regulate interactions, and challenge learners to reconsider or extend their responses. The teacher should be one of the many resources that learners may learn from, not the primary source of information (Pon 2001). Teachers should be sensitive towards gender issues because of traditional disadvantages experienced by girls in mathematics classes (Bevan 2001). Interaction among teachers can also be of great worth. "Experience shows that when teachers across the same year group plan together ... better results and more consistency ... are obtained. This, at the same time, provides the means for sharing and using teachers' creativity and experience and a way to lessen teachers' isolation in their work" (Agudelo-Valderamma 1996:23).

Murray *et al.* (1998:175) describe the teacher's role in the mathematics classroom at the hand of Piaget's classification of physical, social and logico-mathematical knowledge. They say teachers should provide the necessary social knowledge for learners to understand and discuss problems, and to "capture their thoughts on paper". Teachers also need to negotiate social norms for classroom behaviour and interaction, and teach learners how to use mathematical tools like calculators and measuring instruments. But, they say, the teacher's only interference when learner activity is focused on the construction of logico-mathematical knowledge is to monitor social procedures and social needs.

A primary teacher once said: "Teaching a class is like trying to keep a lot of plates spinning on the ends of long rods. Just when you've got one plate spinning, another needs attending to. The trick is to keep them all spinning, and to keep sane at the same time" (Fisher 1995:243). Part of

'keeping the plates spinning' is using various teaching methods to cater for the different learning styles and to make learning a joyful experience.

TEACHING METHODS

The Namibian policy expects teachers to think critically and imaginatively about teaching methods. A variety of methods should be used, allowing active involvement and participation of learners in the process. Teaching methods must facilitate and encourage learning. One of the components of curriculum and instruction reform is to develop learner-centred instructional materials that will support the attainment of its goals and objectives. These will be of special value in helping inexperienced and untrained teachers to teach more effectively (MEC 1993).

Mathematics teaching involves a large amount of 'doing' (Scott Baumann *et al.* 1997). Traditionally mathematics education was about symbol manipulation without paying attention to learners' thinking. The use of manipulatives to encourage learners to make mental relationships is therefore essential in teaching mathematics. "We are often told that children progress from the 'concrete' level of real objects to the 'semi-concrete' level of pictures and then to the 'abstract' level of symbols. However, concrete objects can be used at a high or low level of abstraction" (Kato *et al.* 2002:44). Patricia Moyer (2001) also regards manipulatives as concrete representations of abstract mathematical ideas. Although they are not carriers of meaning or insight themselves, they have both visual and tactile appeal, and learners can gain hands-on experience by manipulating them. "The development of the student's internal representation of ideas, tested on the external representations or manipulatives, is at the heart of what it means to learn mathematics" (Moyer 2001:194). The challenge for a mathematics teacher is to connect the learner's mental actions with the shared tools used for representations, i.e. the manipulatives. She further refers to Piaget's suggestion that children do not have the mental maturity to grasp abstract mathematical concepts presented in words or symbols alone and thus need experiences with concrete materials and drawings for learning to occur.

Jerome Bruner, cited by Scott Baumann *et al.* (1997) argues that children demonstrate understanding in three stages of representation, namely the *enactive stage* of using physical objects, followed by the *iconic stage*, and only after that the *symbolic stage.* Moyer's (2001:185) research on the use of manipulatives in mathematics teaching reveals that teachers categorise mathematics as 'fun math' or 'real math'. The general understanding is that manipulatives are only

being used for 'fun math', which entails enrichment activities, extra-time activities or as a reward for good behaviour. 'Real math', on the other hand, is viewed as learning of basic facts, mathematical procedures and algorithms, preparing for tests, textbook exercises and paper-and-pencil work.

Central to the controversy surrounding the traditionalist view of teaching is the rejection of calculators and computers in favour of computation skills, memorising multiplication tables and addition combinations, and mastering formulas (Devlin 1998, Ring 1998, Colvin 1997, Ernest 1997). Pon (2001), however, argues that calculators and computers enhance the success of constructivist teaching. When they are used, the epistemological authority becomes the student, not the teacher or the text. Writing a strong motivation for information technology, Duill (1997) describes three learning phases: *sensorimotor, operational* and *logiostic*. The logiostic phase would be learning with electronic media, in the context of a medium that can route its own messages. The difference between pencil and paper and the computer, he says, is that the former is a passive medium of record and the latter an active medium of expression, because it has energy that works directly on the notation and can intrinsically represent sound and motion. Cox and Lewis (2002:2) confirm:

> Technology provides a means to carry out operations with speed and accuracy; to display, store and retrieve information and results; and to explore and extend knowledge. The technology of paper and pencil is appropriate in many mathematical situations, but in many other situations, calculators or computers are required to find answers or create images.

I will next discuss the three main approaches to teaching that are practised in Namibia regarding mathematics. They are *learner-centred education* as situated in Social Constructivism, the *cross-curricular* or *thematic integration* approach and the *problem-based* approach that was adopted for mathematics teaching in the Lower Primary phase reform.

Learner-Centred Education (LCE)

With Independence Namibia has committed itself to the Social Constructivist epistemology with learner-centred education as methodology. The basic principles of LCE are listed in the policy *Toward Education for All* (MEC 1993:60):

- The starting point is the learners' existing knowledge, skills, interests and understanding, derived from previous experience in and out of school and lead them towards the less familiar and not yet understood.
- The natural curiosity and eagerness to learn and investigate and to make sense in a widening world must be encouraged by challenging and meaningful tasks.
- Learners' perspective needs should be appreciated and considered.
- Learners should be empowered to think and take responsibility for their own and one another's learning.
- Learners should be partners in, rather than receivers of, educational growth.

During an educational conference held at the National Institute for Educational Development in Namibia in 1998, much had been said about the ideals of learner-centred education.

> The essence of learner-centredness is in the relationship between the teacher and the child more than it is a specific method (Cook, in Sguazzin and Van Graan 1998:91).
>
> Social constructivism is a particularly strong proponent of discovery learning, in the sense that learners construct their own knowledge through the discovery of meaning and in learning to make sense of their world through their conceptual development (Van Harmelen, in Sguazzin and Van Graan 1998:33).
>
> Learner-centred education is a social process and the emphasis in this process is on collaboration and the exchanging of ideas, experiences, values and attitudes. It is a negotiated process where our understanding expands through interaction and active engagement with others (Pomuti, in Sguazzin and Van Graan 1998:14).
>
> Namibian education reform demands that classroom practices are learner-centred and democratic ... emphasising, among other issues, human empowerment and capacity building (Mutorwa, in Sguazzin and Van Graan 1998:11).
>
> The quality of the learning experience will be enhanced ... in classes where teachers have a real belief in the value of learners deconstructing myths and existing knowledge, and constructing knowledge in a collaborative learning activity, or acquiring and practising the skill of locating information (Van Graan, in Sguazzin and Van Graan 1998:56).

Paul Ernest (1997) compares the opposing values of the traditionalist *Back-to-Basics* and the *Progressivist* views of mathematics education as being labelled 'work' versus 'play'. The *Progressivist* view, Ernest says, is a 'child-centred educational ideology' within an environment that encourages spontaneity, freedom, enjoyment, play, practical and experiential learning. The *Traditionalist* view, on the other hand, "denies the value of enjoyment and variety in learning and often rejects the higher levels of learning involved in problem solving and in the uses of

information technology" (Ernest 1997:27 & 28). Etchberger and Shaw (1992:416) say collaborative learning is ideal for the construction of knowledge. "This construction involves gathering information (hands-on), reflecting on the information and relating it to what is known (minds-on), collaborating with others, coming to consensus, and sharing with other groups".

Cross-Curricular Teaching and Thematic Integration

The *Broad Curriculum for Basic Education* (MBESC 1996:29-30) states:

> Formal education structures knowledge into areas of learning and subjects. This does not always reflect the way in which problems and issues present themselves in reality. It is therefore important that learners experience thematic approaches to learning, as well as subject-defined approaches. In the Lower Primary phase ...it is important to synchronise development in vocabulary and concepts in language and reading with vocabulary items in other subject areas so that children have a meaningful context in Mathematics, Natural Science, Social Studies, etc.

The integrated approach to education implies a rejection of rigid divisions between academic and applied knowledge, theory and practice, knowledge and skills, mental and manual. Particular aims can be achieved by combining two or more traditional subjects into one area of learning and the integrated approach is thus advantageous also in terms of time frames (Lehoko, in Avenstrup 1997). Both Lehoko and Myburgh (In Avenstrup 1997) emphasise integration as one of the key pillars of the new outcomes-based education in South Africa. Cross-curricular, broad outcomes focus on the capacity to apply knowledge, skills and attitudes in an integrated way.

Naomi Ritter (1999) cites reports on two studies that were made on the positive effects of integrated learning on learners. The first is that of *Yorks and Follo* who, observing engagement rates in teaching, conclude that learners learn better from thematic, interdisciplinary instruction than from a traditional, single-subject curriculum. The second report from *Schubert and Melnick* confirm this. Integrating curricular content, they say, help learners make vivid connections among the various subject areas, and offer new learning opportunities for learners with difficulties in verbal or mathematical areas. They also conclude that an integrated curriculum increases a positive attitude towards school as well as learners' self-concepts. Michelle Reed (2002) also advocates cross-curricular teaching. Mathematical connections, she argues, are most important in relating mathematics to other areas of the curriculum, and also to learners' daily lives. They help learners to understand mathematics better and to realise it as a useful and

interesting subject to study. However helpful in motivating learners to make mathematical connections, it is among the most difficult to achieve.

Mathematics provides a language for expressing ideas across disciplines, while, at the same time, provides connections linking number and operation, measurement, geometry and data within mathematics itself (Cox and Lewis 2002). Ana Agudelo-Valderamma (1996) makes a case for placing mathematics learning in Colombia in a meaningful context. She argues that, by integrating areas of learning within a well-chosen topic, the children come to understand their world through its interrelations and relevance to themselves. However, there are special features of mathematics learning that justify its standing apart as a separate subject, for example the performance of basic operations which requires continued practice and reinforcement.

As described in Chapter 2, not all reform efforts have been success stories. English primary education introduced the 1988 curriculum with programmes complemented by cross-curricular issues and themes. However, within a few years official support for these was withdrawn and even after the reviewed curriculum had been introduced in 1995, it is still very prescriptive in the programmes of work and the teaching methods of numeracy and literacy (Richards 1997).

Problem-Based Learning (PBL)

Problem-based learning was first developed at McMaster University during the mid-1970's to train medical graduate students. One of the key role-players was Howard Barrows, who claimed that problem-based learning puts many issues into context and gives them meaning, for example problem solving, collaborative learning, critical thinking and independent study (Kaufman 2002, Stover 2002). "Problem-based learning is a natural and powerful way for the brain to learn" (Barrows, as cited in Stover 2002:3).

In mathematics, problem-based learning with the inclusion of problem solving, reasoning, and the use of technology came as a response to the *Back-to-Basics* movement of the 70's. The movement was criticised for placing a low ceiling on mathematical competence, and for traditional practices of drill and rote learning, of facts and skills and applying them in routine exercises, and of hard work and self-denial (Abrantes 2001, Ernest 1997). Murray *et al.* (1998:171) compare the traditional, transmission-type approach, which is 'reconstructed objective knowledge' as opposed to the problem-based learning approach experienced by

learners as personally constructed, 'subjective knowledge'. Although Japanese educators prefer to teach in more traditional, theoretical methods, they follow a 'problem-solving based course' with excellent results (Judson 1999:76).

Problem-based learning was introduced to Namibian teachers during the Lower Primary reform process in1994 as an approach to mathematics teaching. At that stage the Cape Education Department in South Africa had followed the approach with success since 1988 (Murray *et al.* 1998). Problem-based learning is essentially learning that results from the process of working toward the understanding and the resolution of a problem. It is based on the assumption that learners construct their own knowledge through individual and social procedures. In the Namibian context, teaching mathematics through the problem-based approach emphasises the following aspects (Murray *et al.* 1998, Du Toit 1994):

- discussing, understanding and solving real-life problems;
- the utilisation of problem solving as the main vehicle for mathematics learning;
- learner autonomy;
- the ability to reflect on own methods and critical thinking;
- accepting the responsibility for own work and that of others;
- creating a positive self-image and attitude among all learners.

The key principles as based on learner-centred education are thus (Murray *et al.* 1998, Du Toit 1994):

- The problem-based classroom is both well organised and disciplined.
- Learners discover and construct meaning through problem solving, using a variety of informal strategies and methods. No formal methods should be taught or suggested by the teacher.
- Learners construct meaning individually and through social interaction.
- Learners are actively involved in the learning process and accept the responsibility for their own learning.
- Communication (discussions) and social interaction are essential for conceptual understanding.
- Learners have valuable mathematical pre-knowledge and ideas that they bring into the learning situation.
- Young learners may not be limited in developing skills or constructing understanding of mathematical concepts.

- There is not only one right way of computing or solving problems.
- Critical reflection on what was done and how others have done it should be part of mathematics learning.
- What they learn should make sense to learners and cater for their needs. Therefore mathematics teaching should be within context (the local, cultural environment).

One form of PBL is using case studies or narratives of actual events as a problem situation in which learners and teachers examine, discuss and propose solutions. Stories should capture learners' attention from the start with a situation that is realistic and compelling, since learners need to become immersed in the story. It also is important not to complicate the problem with unnecessary information or details (Kaufman 2002). There are various types of problems, ranging from those providing all the necessary information, to those that are open-ended and inquiry-based. That is, there are multiple possible solutions with no single 'right answer'. Content knowledge is enhanced because students are learning the skills needed to find it, use it, and to disseminate it in an appropriate way. Getting to a solution of the problem stimulates active learner involvement, which increases the relevance of the content for learners (Billstein *et al.* 1993). It also supports learning of higher-level concepts and critical thinking as well as their application to practical situations like written and oral presentations. Resulting from social interaction, it emphasises collaborative learning, in which the group product exceeds the sum of learners' individual contributions (Kaufman 2002, Willis 2002). PBL increases retention of knowledge, helps learners to transfer concepts to new problems, enhance student interest in the content, and enhance self-directed learning (Stover 2002).

However, Adhami (2000) argues that teachers who once practised the approach with success, can easily slip back into formal instruction and testing. The reason for this could be that teachers who are fully aware of the advantages of the investigative approach find the 'telling' approach more efficient in terms of time and resources, covering the requirements for standardised testing.

> The investigative approach seems to be at a low ebb at present in Britain and the USA. The development and experimentation with open-ended tasks advocated by the Cockroft report in 1982 has largely ceased, and with it, the excitement and creativity that once characterised much of classroom practice. Course-work, originally intended as a support to classroom learning which is based on problem-solving, has gradually turned into sets of taught procedures, or 'investigational algorithms', leading to formal summative assessment. But the decline of the investigative approach is due to more than the entrenchment of the 'back-to-basics' policies, rigid interpretation of the National Curriculum, and the dominance of written tests. I think that these policies would not have taken place without the tacit approval of

> many mathematics teachers and educators, including those that are, or are seen to be innovative, advocates of 'child-centred' education (Adhami 2000:15).

Next I will discuss the concepts of the mathematics curriculum for the Lower Primary phase and the different types of mathematical knowledge learners should acquire through it.

MATHEMATICAL CONCEPTS

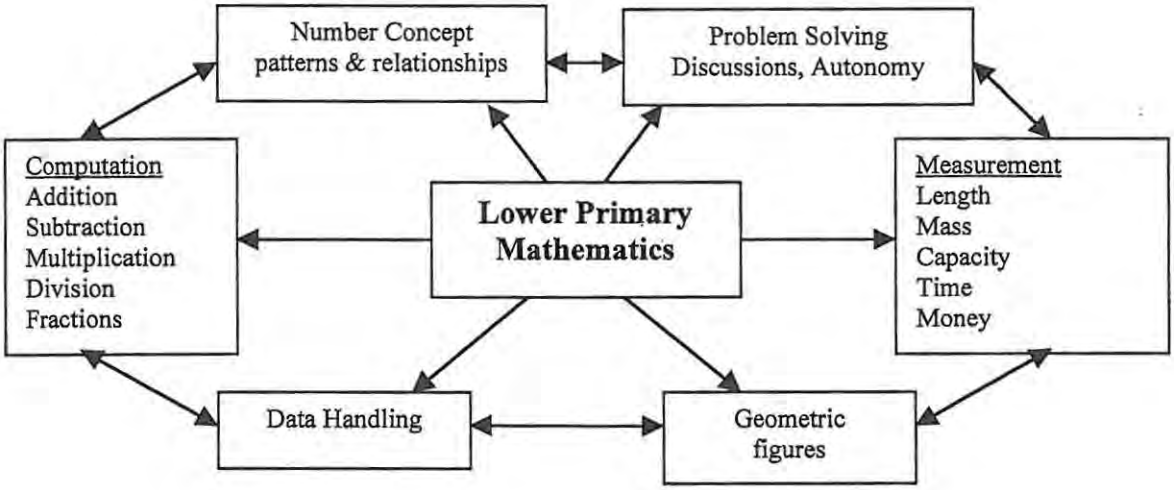

Figure 2: The Lower Primary phase mathematics curriculum

The Lower Primary phase mathematics curriculum in Namibia should be taught in an integrated, problem-based approach (see figure 2). This means that all the components are interrelated and will be integrated in lesson plans, and that the posing and solving of problems will play a key role in conceptual understanding and acquiring mathematical knowledge, skills, competencies and positive attitudes. The 'experts' each have their own opinion about mathematical concepts. Cox and Lewis (2002:1) say: "Mathematics is much more than a collection of concepts and skills; it is a way of approaching new challenges through investigating, reasoning, visualising and problem solving with the goal of communicating the relationships observed and problems solved to others". Doll (1993) and Hardy (1877-1947) as cited by Billstein *et al.* (1993) agree with this, saying that mathematics is a subject in which computational arithmetic plays a small part. The richness in mathematics, the layers of meaning and multiple possibilities, is in making patterns with ideas. Van Oers (2001), Murray (1998) and Ernest (1997) also agree in principle, but they argue that there is a place for some rote practise and 'sums'. "Children need those solid math skills before they can truly connect math concepts" (Murray 1998:1). Learners need to

know number facts and multiplication tables fluently so they can access them instantly for solving problems and applications. Learners also need to know the multiple interconnections between numbers and number facts in order to use them properly, and these are best learned by exploring number patterns, as well as through practise and reinforcement (Ernest 1997). Van Oers (2001) argues that 'real mathematics' is about arithmetical operations (mechanical counting and sums), about abstract structures that have to be applied to concrete situations and problems, and about problem solving in the context of realistic situations with the help of self-invented tools that make sense to the learners.

Kato *et al.* (2002), Murray *et al.* (1998) and Du Toit (1994) describe the different types of knowledge as identified by Piaget useful in shedding light on the ways in which learners learn about numbers:

Physical Knowledge forms the basis for knowledge of numbers. This knowledge is empirically acquired through the manipulation of physical objects or observation. This includes properties of physical objects, e.g. colour, shape, size, etc.

Social Knowledge (the knowledge of words) is obtained through interaction with others. These include: 1) knowledge acquired through listening, observing, reading, asking; 2) clear communication, e.g. meaning of words, pronunciation, illustration, etc.; 3) terminology, such as the number names, days of the week, months of the year, etc; 4) notation, such as the symbols for numbers and operations; and 5) the order in which mathematics operate, e.g. $10 - 3 \times 2 = 4$ (and not 14).

Logico-mathematical knowledge is knowledge constructed through logical reasoning or thinking beyond physical or social knowledge, for example: 1) the sequence of numbers and the patterns they can form; 2) the 'numerosity' of a number, or the realisation of the 'how many' of a number; and 3) the knowledge constructed by each learner from within.

Problem solving forms the foundation for all the other mathematical concepts and it goes hand in hand with learner autonomy and mathematical discussions (see figure 2). Critical reflection on own and others' reasoning and strategies leads to shared learning and conceptual understanding.

Problem Solving

There are quite a number of skills involved in problem solving and investigations. As illustrated in figure 3 learners should be good communicators (oracy, literacy, numeracy and graphicacy).

Learners should have experience with a wide variety of problem-solving methods and opportunities for solving a wide range of problems (Billstein *et al.* 1993). They conclude that the focus in problem solving is on the *process* rather than to obtain the right answer. Broekman (2000) argues that we can help learners improve their problem solving skills by developing different approaches and by increasing their awareness of the skills they already have. One of the most challenging, but most worthwhile, questions to ask learners is if they could solve a problem in a *different* manner. Working on divergent exercises gives learners the opportunity to be more flexible and more willing to explore and take risks. Discussions of the different strategies lessen stress and 'maths anxiety'. For him, problem solving is not equal to applying acquired knowledge. He says that problem solving and problem posing go hand in hand, and reflection on the process is helpful in becoming a better problem solver.

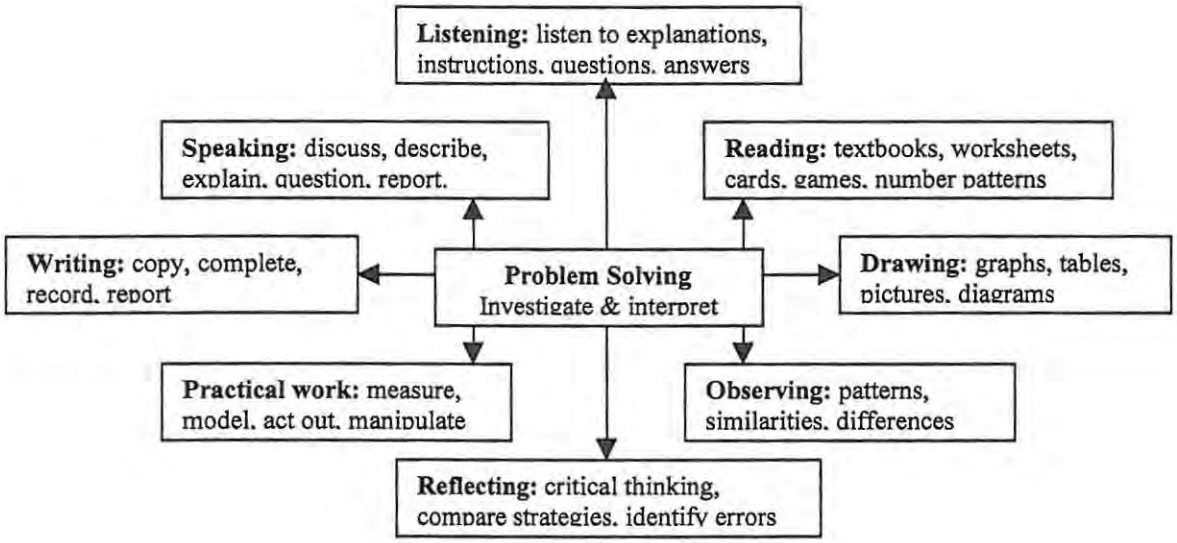

Figure 3: The skills involved in problem solving

Problem solving is at the heart of 'doing mathematics'. When learners are requested to apply their knowledge of numbers, symbols, operations, measurement and other mathematical concepts, 'mathematics power' emerges (Cox and Lewis 2002:1). Billstein *et al.* (1993) describe the problem solving process in four steps: 1) understanding the problem; 2) devising a plan; 3) carrying out the plan and 4) looking back (reflection). Teachers should carefully choose contexts, names and pictures in mathematics teaching (problem solving) in order to enhance realistic teaching (Du Feu 2001). Murray *et al.* (1998:176) elaborate on this, saying "...the choice of problems should be based on thorough content analysis and a good understanding of how students develop concepts and misconceptions". Sometimes teachers should pose well-structured

problems that simply require the application of an algorithm or the interpretation of a relationship. However, learners should also experience non-routine problems that require some imagination and careful reasoning to solve (Cox and Lewis 2002, Willis 2002). Abstraction of a mathematics model from a given situation is an important part of mathematics, and contexts provide a means of dealing with the process. Equally important for the learner is to relate the solution of a model to the original situation. "Applied questions must present mathematics in relevant situations in such a way that they show real mathematics being used in a realistic way" (Du Feu 2001:4).

Doherty *et al.* (1998) describe the traditional view of problem solving as having a closed or a single-answer solution. In order to reach this solution, sufficient information should be acquired and organised in a specific manner. Ernest (1997:29) explains the traditional and contemporary views of problem solving as follows:

> Traditionalist view is that ... problem solving and investigations are frills; distractions from the real work of learning mathematics. It is conceded that the mathematically more able might be allowed to spend time on such activities as a reward for their hard work and success, after they have mastered the basics and their applications. In contrast, the Progressivist view is that virtually *all* mathematics should be learned through problem-solving, practical projects and investigational activities. These develop children's autonomy, result in good attitudes, and mean that the basic facts and skills are learned painlessly as an incidental outcome.

Learner Autonomy

The guiding policy envisions a self-reliant and prosperous Namibia. In order to achieve this, we need our young people to learn to think independently and critically, and to master strategies for identifying, analysing, and solving problems. Most important, they need to be confident that they have the ability to contribute productively to their society, to help it grow, and to participate in governing it (MEC 1993). Constructivist researchers realise the need to change teachers' stances towards learners, with the learners' own efforts to understand at the heart of teaching. They succeed in convincing some teachers to critically reflect on their traditional, hierarchical views of mathematics learning and allow learners to use their own invented strategies to solve problems (Prawat 1991). Teachers should encourage and accept learner autonomy and initiative and create a classroom learning environment where mathematical meanings and understandings are socially negotiated, and where personal and collaborative ideas are explained and justified

(Pon 2001, Taylor & Campbell-Williams 1993). Abrantes (2001) links autonomy to the reflexive and purposeful use of knowledge.

Edwards (2003), Murray *et al.* (1998) and Du Toit (1994) see the maintenance of learner autonomy as a prerequisite for success in Lower Primary mathematics. This means that learners should never experience any obligation to use specific methods, strategies or operations to solve problems, or any specific computational methods. They should be allowed to choose methods according to their own individual judgement. They should also accept individual and collective responsibility to assess the sensibility of their outcomes and to identify and correct own errors. Du Toit (1994) further states that, through discussions and demonstrations of methods used, the teacher should expose learners to all possibilities. This would guide learners in an informal way to refine their computational methods and to more sophisticated ways of recording. Ernest (1997) agrees that errors must be acknowledged and welcomed as an essential part of the learning process. It is only if learners take risks and sometimes make errors, that teachers can gain evidence of what they have learned, before helping learners to correct or extend their knowledge.

Mastrull (2002) describes a typical mathematics lesson in an eighth grade class in Japan as follows: After reviewing the previous day's problems, new problems are being solved by learners, working in pairs or small groups. After comparing and discussing solution methods, the teacher would highlight and summarise the main points before assigning homework. She further says that Japanese learners decide 40% of the time on their own strategies for problem solving, rather than using a teacher-prescribed method.

Mathematical Communication

Young children initially choose to solve problems verbally, either by *direct modelling* or by using manipulatives or counters as representations. Direct modelling would be to physically acting it out or to draw the problem situation (as shown in figure 4). After direct modelling learners usually are ready to advance to *mathematical modelling* using numbers and symbols. "This change of strategy from direct modelling to mathematical modelling is an extremely important conceptual breakthrough and pupils need to make this breakthrough themselves in a variety of problem contexts. It is by doing this that the operations ... become meaningful to pupils" (Du Toit 1994:2.3). Kato *et al.* (2002) confirm this with their research findings on how

young children graphically represent small groups of objects. They conclude that representation of numbers precede abstraction.

> These findings support Piaget's theory that children represent their *thinking* about reality. When children are still thinking about individual objects, they externalize this thinking in their drawing or writing on paper. When their thinking advances to the level of thinking about composite wholes, they begin to externalize the thinking with single numerals (Kato *et al.* 2002:43).

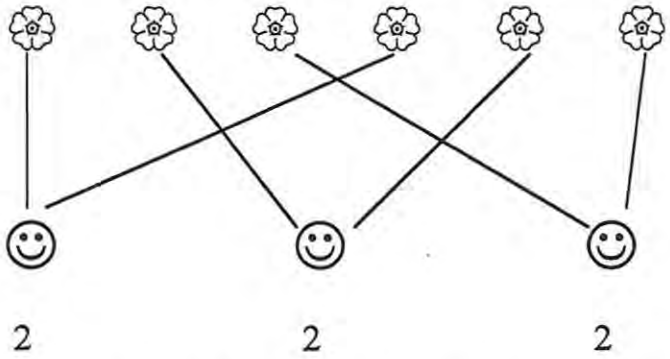

Figure 4: Illustration to indicate 6 flowers divided among 3 children.

Social interaction and effective communication determine the success of problem solving. Edwards (2003:313) argues that there is "...a relation between talk amongst peers and metacognitive activity". Learners should explain their methods and solutions to their peers in such a manner that others may follow and understand. Learners should listen attentively in order to recognise differences and similarities between strategies and methods. The teacher should ensure that discussions remain on track and that all learners participate. Learners' contributions and reflections on strategies used should be carefully recorded on (for example) the chalkboard, in order to facilitate fruitful discussions, social interaction, comparison and evaluation. The teacher should not interfere in explanations, except for providing guidance in terminology and symbolism (Du Toit 1994). However, Van Oers (2001:74) argues that the teacher represents the 'cultural history' of mathematics and should thus participate in classroom discourse as a real participant and not just as a guide. In this role the teacher will suggest possible solutions, strategies and concepts.

Communication, for Vygotsky, is a "...collaborative endeavour on publicly pooled meanings" (Van Oers 2001:67). When learners solve problems in mathematics, there are periods when they seek a forum in which ideas may be validated. Interaction with other learners is often in uncertain, imprecise language and may be supported to a lesser or greater degree by objects or

symbols (Simmons 1999). Mathematics provides students with opportunities to grow in the ability to read, write and discuss numbers, variables, equations, figures and graphs. The ability to shift between verbal, graphical, numerical and symbolic modes of representation enables learners to eventually formulate, understand, solve and communicate technical information in the workplace. Learners should be confronted with problems requiring them to translate between representations, both within mathematics and between mathematics and other areas. The aim is to communicate findings orally and in writing, and to develop displays illustrating the relationships they have observed or constructed (Cox and Lewis 2002).

Taylor & Campbell-Williams (1993) highlight the role of language as a major constraint for learners to gain mathematical knowledge. Gorgorio and Planas (2001) did an extensive research in Spain on teaching mathematics in multilingual classrooms. They focused their research in two areas: language as a social tool in the process of sharing meanings, and language as a vehicle in the construction of mathematical knowledge. They conclude that, in the mathematics class, the linguistic barrier goes further than barriers arising in simple everyday communications. Teachers find it difficult to know about the thinking processes of learners. Using a simpler language sometimes add to the confusion and it is difficult to find resources beyond verbal language.

Learners are provided with mathematical language, meanings, connections and strategies. They are also provided with artefacts such as diagrams, graphs, physical tools (rulers, calculators) and how to 'read' them. The teachers, texts, peers and others provide them with methods. These are tools with which students think and speak mathematically (Lerman 2001). When students can communicate their understanding, then they have truly learned (Pon 2001).

> Culture, language and meaning precede us. We are born into a world already formed discursively. The reality or otherwise of the world or the certainty of our knowledge of it are not the issue: the issue is that we *receive* all knowledge of the world through language and other forms of communication (Lerman 2001:91).

6. CONCLUSION

As human beings, we manipulate and are being manipulated by mathematics every day of our lives. In a dynamic world that is constantly being changed by its inhabitants, it is essential to keep the pace and solve the problems coming your way. If you are lucky, you will be taught these skills from childhood, and problem solving won't be a problem at all! Billstein *et al.*

(1993:4) quote Rene Descartes (1596-1650) as saying: "Each problem that I solved became a rule which served afterwards to solve other problems".

Peter Huckstep (2001) says within certain limits, we may connect mathematics and social values by the way in which we teach. Apart from being a useful tool, which can be applied to human welfare, it is also a vehicle for embodying some social values in a liberal democracy. Pythagoras is characterised as saying that the world is essentially number. Plato was convinced reasoning about mathematics attains a deeper understanding of the source of reason and hence of 'good living'. For St. Augustine aesthetic pleasure is a function of mathematics. Two further strong views come from Billstein *et al.* (1993:4): "[T]he purpose of mathematics is to create order out of chaos" and from Devlin (1998:2): "Mathematics is the fuel we burn to drive the information age".

After I have investigated mathematics education from a wide perspective, I can conclude that it would be to the advantage of the learners to discover mathematical knowledge and understanding, skills and competencies, values and attitudes, that are necessary to cope in a demanding society, through a wider variety of methods and strategies. Tom Loveless (2003) and Keith Devlin (1998) suggest we should balance competing views and go forward to the *New Basics,* a middle ground of multiple opportunities. Learners would not be able to cope with the abstract patterns, relationships and structures in contemporary mathematics without problem solving skills. Neither would they be able to cope with the demands of global life without mental skills and greater insights for the successful use of today's technological computational aids. "It's so easy in education to get swept up in one way or the other, but there's never a 'the way' to do anything. What you need is lots of different styles for lots of different kids" (Phillips, as quoted in Murray 1998:3).

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RESEARCH PROPOSAL

RHODES UNIVERSITY
DEPARTMENT OF EDUCATION

RESEARCH PROPOSAL

Presented in partial fulfilment of the requirements for the degree

MASTER OF EDUCATION

(GENERAL EDUCATION THEORY AND PRACTICE)

CANDIDATE: H.J.M. KRUGER
No. 602K2745
SUPERVISORS: U. VAN HARMELEN
W. HUGO

PROVISIONAL TITLE:

Teaching School Beginners About Problem Solving in Mathematics: An Action Research Case Study of two Grade one Classes in Namibia

1. FIELD OF RESEARCH

General Education Theory and Practice

2. PROVISIONAL TITLE

Teaching school beginners about problem solving in Mathematics: An action research case study of two grade one classes in Namibia.

3. CONTEXT

Problem solving is an important component in Mathematics learning and teaching. The conventional notion of teaching problem solving as an application to mastered concepts with specific methods and steps has changed. In recent years social constructivist ideas of solving problems in a social context have become the foundation to teaching mathematical concepts. This approach supposes the collaborative construction of conceptual understanding through discussions and learner autonomy in applying own strategies and methods to problem solving (Murray *et al* 1998, Du Toit 1994). The opposing views to the role of problem solving in Mathematics are discussed by a number of researchers. Doherty *et al* (1998) describe the traditional view of problem solving as having a closed or a single-answer solution. In order to reach this solution, sufficient information should be acquired and organised in a specific manner. Ernest (1997:29) explains the traditional and contemporary views of problem solving as follows:

> Traditionalist view is that ... problem solving and investigations are frills; distractions from the real work of learning Mathematics. It is conceded that the mathematically more able might be allowed to spend time on such activities as a reward for their hard work and success, after they have mastered the basics and their applications. In contrast, the Progressivist view is that virtually *all* Mathematics should be learned through problem-solving, practical projects and investigational activities. These develop children's autonomy, result in good attitudes, and mean that the basic facts and skills are learned painlessly *as an incidental outcome* (my emphasis).

For Broekman (2000), problem solving is not equal to applying acquired knowledge. He argues that problem solving and problem posing go hand in hand, and that reflecting on the process is helpful in becoming a better problem solver. Cox and Lewis (2002:1) say: "Mathematics is much more than a collection of concepts and skills; it is a way of approaching new challenges through investigating, reasoning, visualising and problem solving with the goal of communicating the relationships observed and problems solved to others".

However, there are those who firmly believe in the inclusion of traditional memorisation of multiplication tables and addition combinations, and also the structured methods of computation. Van Oers (2001), Murray (1998) and Ernest (1997) argue that there is a place for some rote practice in Mathematics. Learners need to know number facts and multiplication tables fluently so they can access them instantly for solving problems and applications. Learners also need to know the multiple interconnections between numbers and number facts in order to use them properly, and these are best learned by exploring number patterns, as well as through practice and reinforcement (Ernest 1997). "Children need those solid math skills before they can truly connect math concepts" (Murray 1998:1). Van Oers (2001:61) argues that 'real Mathematics' is about arithmetical operations (mechanical counting and sums), about abstract structures that have to be applied to concrete situations and problems, and about problem solving in the context of realistic situations with the help of self-invented tools that make sense to the learners.

With the Independence of Namibia in 1990 a totally new education system was implemented. Against the background of the social constructivist epistemology, learner-centred education has been adopted as an approach to teaching and learning. The education reform process for Lower Primary began in 1995 with the development of syllabuses and support materials, followed by national and regional training courses. The *Lower Primary Task Force*, assisted by several projects, coordinated and supervised the development and implementation process. A number of consultants from various countries have been invited to assist and advise. For Lower Primary Mathematics the consultant was Ansie du Toit, Subject Advisor and Mathematics specialist for Junior Primary Education in the Western Cape, South Africa. She conducted a workshop on the problem-based approach to Mathematics teaching in Windhoek in 1994, after which the approach had been piloted in a number of Windhoek schools. In 1996 she conducted a second workshop to the *Central Training Team* in preparation of the grade two reform. Needless to say that the problem-based approach to Mathematics was not part of reform training on national level for grade one in 1995. Neither had the Teacher Educators of the four Colleges of Education been involved in the reform training process.

The *National Learner Baseline Assessment* (MEC 1994) researched levels of achievement in Mathematics and English proficiencies in grades four and seven prior to the reform initiative, but since then not much research had been done in the Mathematics area and certainly not on Lower Primary level. The *Reform Forum,* a journal that is published by the *National Institute for Educational Development* and the *Ministry of Basic Education Sport and Culture* in Namibia, gives relevant information about the reform and serves as useful source for educators in their

practice (Dahlstrom and Tjipueja 1997). Since the first publication in April 1994 about a hundred articles of educationalists, both local and abroad, had been published, of which only four have dealt with mathematical issues. The lack of interest in Mathematics is confirmed by the Presidential Commission's remarks in its report on page 112:

> Much attention is given to training primary teachers in language skills but much less attention has been directed to numeracy training... Many teachers feel inadequate in Mathematics education and are unable to give the children the skills that are needed to succeed in upper primary and secondary level... Unless the foundations are secured, it will be extremely difficult to build mathematical and scientific success at secondary level (Government of the Republic of Namibia 1999).

I have decided to investigate grade one teachers' perceptions of problem solving and how they incorporate it in Mathematics teaching when commencing with formal teaching after the *School Readiness Programme* has ended. My motivation rests on four basic reasons:

- I have been a grade one teacher for five years during the reform and I have successfully implemented the new approach in my own classroom.
- I am currently an Education Officer at the National Institute for Educational Development (NIED), responsible for teacher development programmes.
- During 2002 I did teacher development workshops in six of the seven educational regions of Namibia, mainly on Language Development and Continuous Assessment. Nineteen percent of the teachers indicated on the workshop evaluations that Mathematics is the area where they need the most support.
- I want to test my assumption that Lower Primary teachers teach Mathematics in the way that they have been taught, i.e. in a traditional, compartmentalised approach.

4. RESEARCH GOALS

The goals of the research will be to:

- Find out the approaches to Mathematics teaching the teachers have been trained in (if any) and if they still apply them.
- Explore the ways in which teachers approach problem solving in grade one classrooms, i.e. how they interpret the subject syllabus.
- Explore ways in which I can intervene and support teachers in implementing the problem-based approach to Mathematics teaching.

The outcomes would be to:

- Improve teaching and learning in the specific classrooms.

- Establish the kind of support teachers would require adopting the new approach on a wider level.
- Share the findings with colleges of education and other stakeholders, suggesting recommendations for programme improvement and continuous professional development and support.

5. RESEARCH METHODOLOGY

This small-scale study will be conducted in the interpretative paradigm, using an in-depth case study in order to lend me the opportunity to understand the subjective world of teachers' experiences and their meaningful reflective actions. It will also employ active involvement in the process of negotiated meaning (Janse van Rensburg 2001, Cohen *et al* 2000, Connole 1993). Since the study will aim at teachers' professional development, participatory action research might be the appropriate method of research (Cohen *et al* 2000, Kemmis & Wilkinson 1998, Henry & McTaggart 1996, McNiff *et al* 1996). It would recognise my role as researcher to be facilitator, guide, formulator and summariser of knowledge, while the teachers would get the opportunity of improving and reforming their practice through self-understandings and judgements (Cohen *et al* 2000, Henry & McTaggart 1996, Lotz 1996).

I intend to acquire permission from the regional director, school principal and the teachers involved to do the research study in two different grade one classrooms at a primary school in Windhoek, the capital of Namibia, and to use the data collected for writing a research paper. I intend to begin with classroom observations after the completion of the *School Readiness Programme* for grade one learners and complete the data collecting process within six weeks, excluding the May school holidays. The research process would develop through a series of cycles of planning, acting or implementing, systematically observing and reflecting (Cohen *et al* 2000, Lotz 1996). I intend to collect data as described by Cohen *et al* (2000) and Lotz (1996):

- semi-structured interviews (tape-recorded and transcribed) to determine the teachers' educational development (training) and their knowledge and understanding of teaching approaches;
- classroom observations to familiarise myself with the teaching practices;
- keeping a research journal (file) to collect, analyse and reflect on records of events (planning meetings, observation field notes and transcriptions and informal discussions with teachers);
- teachers' journals (diaries) with accounts and critical reflections on processes of development and change.

Data will be labelled, coded and categorised. Data analysis and interpretation work together in the construction of meaning (Ely *et al* 1997, Lotz 1996), therefore any emerging issues will be analysed and investigated continuously. I will negotiate the data analysis and interpretation with the research participants and involve them in the process as far as possible before writing the final research report. Ely *et al* (1997:223) argue, "...writing reveals an interpretation as filtered through your own sensibilities and theoretical perspectives".

6. RESEARCH TIMETABLE (February 2003 – June 2003)

- Selection of a school with a grade one teacher with a *Basic Education Teachers Diploma* (BETD) education and one who had teacher training in the previous dispensation.
- Permission obtained from the regional Director of Education.
- Negotiations with the principal and two teacher participants involved.
- 7 March 2003: School visit for interviews and discussions.
- 25 & 26 March 2003 (after completion of the School Readiness Programme): Classroom observations for preliminary data collection.
- 1 & 2 April 2003: Workshop and classroom observations for data collection.
- 22 & 23 April 2003: Workshop and classroom observations for data collection.
- 10 & 11 June 2003: Workshop and classroom observations for data collection.
- 17 June 2003: Final data collection.
- June & July 2003: Completion of data analysis and write up.

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TEACHING SCHOOL BEGINNERS ABOUT PROBLEM SOLVING IN MATHEMATICS: AN ACTION RESEARCH CASE STUDY OF TWO GRADE ONE CLASSES IN NAMIBIA

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TEACHING SCHOOL BEGINNERS ABOUT PROBLEM SOLVING IN MATHEMATICS: AN ACTION RESEARCH CASE STUDY OF TWO GRADE ONE CLASSES IN NAMIBIA

1. ABSTRACT

Mathematicians and researchers across the globe have theorised and speculated about education reform movements, which aim for more than just structural knowledge where it concerns Mathematics. This action research study is based on the findings of a pilot study about 'Problem-based Learning', using this as a basis to investigate the relationship between the intentions of the Lower Primary Mathematics curriculum and its implementation at classroom level. This paper reports on a case study of two grade one teachers' perceptions of problem solving as a key component of Mathematics learning and how the implementation of the problem-based approach could be supported through intervention. Data was gathered from a series of cycles of planning, acting, observing and reflecting. Analysis of the data indicates that teachers' professional development lies within a willingness to change and in reflexive practice. Given focused support to teachers could result in the application of contemporary approaches to Mathematics teaching, with an overall improvement of constructivist-oriented learner-centred education.

2. INTRODUCTION

Problem solving is an important component in Mathematics learning and teaching. The traditional notion of teaching problem solving as an application to mastered concepts with specific methods and steps has changed. In recent years, Social Constructivist ideas of solving problems in a social context have become the foundation to teaching mathematical concepts. This approach supposes the collaborative construction of conceptual understanding through discussions and learner autonomy in applying their own strategies and methods to problem solving.

The action research covered in this paper was done in two grade one classes at a primary school in Windhoek, Namibia. The purpose of the research was to investigate teachers' perceptions of problem solving and how they incorporated it in Mathematics teaching when commencing with formal teaching after the *School Readiness Programme* had ended. Further, it aimed to explore ways in which I could intervene and support teachers in implementing the problem-based approach to Mathematics teaching. The outcomes would be to improve teaching and learning in the specific classrooms, to establish the kind of support teachers would require to be able to adopt the new approach on a wider level, and to share the findings with Teacher Educators and Advisory Teachers, suggesting recommendations for programme improvement and continuous professional development and support.

3. METHODOLOGY

This small-scale research study was conducted in the interpretative orientation. I used a case study, because "... case studies catch the dynamics of unfolding situations" (Cohen *et al.* 2000:189). It lent me the opportunity to understand the subjective worlds of teachers' experiences and their meaningful reflexive actions and also employed active involvement in the process of negotiated meaning (Janse van Rensburg 2001, Cohen *et al.* 2000). Since the study aimed at teachers' professional development, I chose participatory (collaborative) action research as the appropriate method of research. It would recognise my role as researcher to be "facilitator, guide, formulator and summariser of knowledge, and raiser of issues" (Cohen *et al.* 2000:230), while the participating teachers would get the opportunity of improving and reforming their practice through self-understandings and judgments (Cohen *et al.* 2000, Henry & McTaggart 1996, Lotz 1996). "At its best, it is a collaborative social process of learning, realised by groups of people who join together in changing the practices through which they interact in a shared social world" (Kemmis & Wilkenson 1998:22-23).

The research initiative was conducted in the grade one classes of Terese and Soria at a primary school in Windhoek, the capital of Namibia. Both the teachers taught multi-lingual classes of 38 learners each through the medium of English, and both the teachers were known to me. (I initially intended to do the research study in a rural school, but time and finances were limitations.) I later found this to be to my advantage, because I could immediately start off with a relationship of trust and openness and I did not need to break down barriers first.

I began with the first data collection when the teachers started teaching the formal Mathematics programme after the completion of the *School Readiness Programme* for grade one learners. The research process developed through a series of cycles of planning, acting or implementing, systematically observing and reflecting (Cohen *et al.* 2000, Kemmis & Wilkenson 1998, Lotz 1996, McKernan 1996, McNiff *et al.* 1996). I collected data through short semi-structured interviews, which were audio tape-recorded and transcribed, to determine the teachers' educational development (training) background, their application of teaching approaches to Mathematics and their knowledge and understanding of problem solving in Mathematics learning. The transcripts were handed to the teachers to check for accuracy and whether they wanted to add or qualify points in the scripts. These interviews were very short and to the point and provided me with just enough background information for the first cycle of observations and

planning. I also conducted classroom observations (some video and some audio tape-recorded) to familiarise myself with the teaching practices and developments. I found the camcorder to be ideal to distance myself from the learners and an excellent tool for teachers to look back and reflect on their own lessons. I further took photographs of moments that indicated the quality of engagement of learners (Lotz 1996, McNiff *et al.* 1996).

I kept a data file to collect, analyse and reflect on records of events, viz. interview transcripts, research journal, observation field notes, planning meetings and teachers' reflections. The latter had also been audio tape-recorded and transcribed. Issues related to the research goals had been coded and reflective remarks written in the margins. I further used the teachers' diaries with accounts and critical reflections on the processes of development and change (Cohen *et al.* 2000, Lotz 1996, McNiff *et al.* 1996). I expected more from this activity, but because of the teachers' workloads and extra-mural programmes, they were reluctant to spend more time writing down reflections. I tried to overcome this limitation by asking more questions during oral reflection sessions and also having the teachers write me their mathematical stories in the final wrap-up session. I also invited an outside expert to the last round of classroom observations, reflections and planning workshop. My 'critical friend' (McNiff *et al.* 1996) was a volunteer Mathematics trainer for a Swedish project who had expertise in the field of Lower Primary Mathematics. I could identify with Lotz (1996:89), being a "novice researcher with little knowledge of qualitative research methods and techniques" and I had to discover my way through data collection, interpretation and analysis.

Data was analysed within a qualitative research paradigm. Data analysis and interpretation or reduction worked together in the construction of meaning (Ely *et al.* 1997, Lotz 1996, Miles & Huberman 1994), therefore emerging issues had been interpreted and investigated continuously without imposing judgment at a too early stage (Cohen *et al.* 2000, Patton 1990). Primary patterns in the data were identified, coded and categorised in a table (Miles & Huberman 1994, Patton 1990).

The research results are presented in a narrative and descriptive form. Ely *et al.* (1997:223) contend that "...writing reveals an interpretation as filtered through your own sensibilities and theoretical perspectives". As suggested by Lotz (1996), Miles & Huberman (1994) and many others, I negotiated the analysis and interpretation with the research participants before writing the final research report. I acquired permission from the regional director, school principal and

the teachers involved to use the data collected in a written report. In the next section I will give a narrative of the research process, and how data was collected, captured and interpreted.

4. RESEARCH DISCUSSION

After the initial interviews the research process developed through a series of cycles of planning, implementing the lesson plans, systematically observing, reflecting and re-planning, etc. (Cohen *et al.* 2000, Kemmis & Wilkenson 1998, Lotz 1996, McKernan 1996, McNiff *et al.* 1996). These were done in four contact sessions of two days each from the end of March until mid-June 2003. I would visit each teacher for an hour per day to observe and record her Mathematics lesson. In the classrooms I played the role of non-participant observer. After school we would meet for two hours looking at the video-recorded lessons or parts thereof together and the teachers would then reflect on their strengths and weaknesses. A session of researching new information and of discussing further planning would complete the afternoon session. During these sessions I was actively involved as a facilitator, guide and resource person. A final contact session served to wrap up the data collection with each teacher writing up her Mathematics story.

Results

The interviews

The interviews revealed that the research participants had their teacher education or training in two different paradigms. Terese had a four-year Pre-Primary teacher training at a formerly white college of education and she had seven years of teaching experience in the Lower Primary phase. She had no training in teaching methodologies for Lower Primary Mathematics and she relied mainly on a teachers' guide to Mathematics that contained lesson plans for the whole year to guide her through Mathematics teaching. "Maths can sometimes get boring" (7 March 2003) was the way she experienced Mathematics teaching. She expressed excitement about the prospective research activity in her reflections after the interview, saying "New ideas is [*sic*] a source of inspiration and motivation ... a new challenge" (7 March 2003).

Soria on the other hand, had a three-year Lower Primary teacher education for the *Basic Education Teachers' Diploma* (BETD), a course devised for teacher education for all races of Namibia after Independence in 1990. She was uncertain about the approach to Mathematics teaching she had been trained in and only named counting as a teaching approach. She used the

same teachers' guide as Terese for guidance. She had three years of teaching experience in the Lower Primary phase. In her reflections after the interview she wrote about her first reaction when she had heard about the research: "I was scared, because Maths is a subject few people are interested in" (7 March 2003). However, after the interview she felt 'encouraged' and eventually could declare: "I now enjoy Maths" (1 April 2003).

Regarding their understanding of problem solving in Mathematics, Soria argued that in posing a problem she just wanted a solution or a correct answer from a child. For Terese problem solving was an application of learnt concepts. Both had done problem solving activities in small group settings and both regarded problem solving in grade one only in relation to addition and subtraction.

Classroom Observations

As non-participant observer in the classrooms I could monitor and evaluate the intervention. "This feeds forward into a revised plan and set of procedures for implementation, themselves accompanied by monitoring and evaluation" (Cohen *et al.* 2000:234). The very first lessons that I observed contained a variety of interesting activities. However, they proved to be more teacher-centred in both classrooms with teachers leading the various counting activities that were done only in chorus, whole-class responses to questions and the teachers handing out all materials themselves. Although group work was done, it focused more on individual assignments. Problem solving was done with small groups using concrete materials, but both teachers demonstrated procedures, writing numbers on the chalkboard themselves. In retrospect a few weeks later Terese commented: "I even said the answers" (10 June 2003). Both classrooms had learners' desks organised in three large groups ordered in parallel rows, with a carpet in front of the classroom used for various group activities. Terese had a Mathematics corner installed with a 100-chart, portable chalkboard, abacus and various materials stored in containers. Terese never changed the sitting arrangement, but Soria soon installed a Mathematics corner and she re-arranged learners' desks to be in five groups of six and one group of eight learners. Both classroom settings enhanced collaborative learning as described in the Namibian policies *Toward Education for All* (MEC 1993) and the *Broad Curriculum* (MBESC 1996).

With every following observation session I experienced growth and development in the areas of learner-centred education, classroom management and dealing with problem solving, especially in the case of Terese. Soria experienced some ups and downs and especially after a long weekend

and school holidays she struggled to put together a coherent lesson, only to perform excellently the following day.

Reflections

Critical conversations after looking at video-recorded lessons played a major role in the research study. All the reflective conversations had been audio tape-recorded and transcribed. Although time-consuming, the transcription procedure helped me to reflect about the data. McNiff *et al.* (1996:73) name three purposes of documenting critical reflections: 1) It celebrates and records significant moments of change in practice. 2) It enables you to show changes in thinking over time. 3) It provides evidence that the validation process has been continuous and formative. Cohen *et al.* (2000), Henry & McTaggart (1996) and Lotz (1996) describe reflexivity as being central to action research, giving the teachers the opportunity of improving and reforming their practice through self-understandings and judgments. It further provides evidence of the processes of learning and "indicates connections between actions and outcomes" (McNiff *et al.* 1996:89). Kemmis and Wilkenson (1998:31) contend that reflexivity is the relationship between the *objective* (externally given) and the *subjective* (internally understood and interpreted);

> ... both of which are necessary to understand how any practice is really practiced, and how it is constituted historically and socially, and how it can be transformed if people critically transform what they do to enact the practice, transform the way it is understood and transform the situations in which they practice.

From the very beginning there was an openness from the research participants in sharing their experiences on their own strengths and weaknesses. Terese set very high standards for herself and on a number of occasions expressed her wish to teach 'perfectly' (26 March, 1 April, 11 June 2003). She easily felt discouraged by the little mistakes she had made or little things she neglected to do (26 March, 2 April, 11 June 2003), eventually accepting that what she did *then* was her best and that she would improve and get more experienced over time (11 June 2003). McNiff *et al.* (1996:22) cite Griffiths (1990:34): "... the research proceeds by doing and by making mistakes in a self-reflective spiral of planning, acting, observing, reflecting, planning, etc."

I experienced Soria to express feelings of confidence in herself, but uncertainty of how others would regard her performance (26 March, 1 April, 23 April, 10 June 2003). Like Terese, she also continuously referred to the mistakes she made (25 March, 1 April, 22 April, 10 June 2003), but finally came to the realisation that as a human being "I cannot expect a quality lesson without any

mistakes. Mistakes happen unexpectedly" (11 June 2003). McNiff *et al.* (1996:48) confirm this, saying "The best models represent the idea of action research as non-linear, accepting that people are unpredictable, and life (even at work) does not follow a straightforward pattern".

Planning

McNiff *et al.* (1996) view the researcher as a key resource for sharing information, offering feedback, providing support and challenging participants to move their own thinking forward. The aim of planning within the cycle of action research is to work collaboratively towards improving practice and advancing knowledge (McNiff *et al.* 1996), therefore we would always compare theory to lesson outcomes and learners' responses during planning sessions. Cohen *et al.* (2000:237) argue that "...action research is a blend of practical and theoretical concerns, it is both action and research".

Our first planning session began with exploring the views of Kemmis and Wilkenson (1998) on *Participatory Action Research,* its meaning and expectations. Following that, we analysed the syllabus requirements for problem solving and the basic principles of the *Problem-based approach to Mathematics* as the adopted approach for the Lower Primary reform in Namibia, as described by Murray *et al.* (1998) and Du Toit (1994). After every round of classroom observations and reflections I would give critical feedback on areas that needed further development as well as praise for positive changes and initiatives. Built around these, the teachers would then identify areas for improvement and plan follow-up lessons. Although our workshops addressed Mathematics teaching as a whole, our main focus remained on the area of problem solving.

The five grade one teachers at the school were in the habit of gathering for a planning session once a week. They would plan the key topics for all their subjects and share ideas on reading texts, worksheets, assessment, etc. in order to have uniformity and to support new teachers. Following this the finer detail for daily lessons would be planned on an individual basis. Terese spent much time on lesson planning. "I need to prepare in detail. I need to think what I will say, how I will ask a question" (11 June 2003). In the beginning she would have a broad outline on a weekly plan for Mathematics, but would use more detailed plans on separate cards. However, she had too many activities for one day and rushed through in order to do all of them. After our workshop session on lesson planning she tried out the new lesson plan format with great success and she reflected: "I want to remember for the rest of my life to teach fewer aspects [per lesson],

but to teach them thoroughly" (1 April 2003). She strived to plan creative activities " ... where teacher and learners will enjoy each other" (1 April 2003).

Soria's lessons would rank between highs and lows and she consulted the teachers' guide during lessons. It was only in the second last session that she confessed: "I don't know whether I'm on the right track, but ... I don't like to prepare ... I will maybe only write two sentences for my whole lesson. Once I start something [the lesson], things are just coming on itself ... But after the lesson I come back to the teachers' guide and see what I missed out and I have to put in another day" (11 June 2003).

Acting and Implementing

McNiff *et al.* (1996:17-18) differentiate between three different types of action. 1) *Informed action* is the critical investigation of actions and motives and being open to alternative viewpoints in order to reduce personal biases. 2) *Committed action* is to commit to the project as a stakeholder with personal values who does not merely implement the dictates of other people. 3) *Intentional action* is making plans and implementing them and then monitoring and evaluating the action.

I purposefully did not engage in lesson demonstrations or parts thereof, because I wanted my research participants to experience the endeavor as their own empowerment, their own developmental growth, and not merely an imitation of another person's ideas. I wanted them to internalise their new understandings so that the research initiative would be the beginning of a process of change. The two participating teachers therefore carried out the acting and implementing part while I recorded the lessons for them to observe afterwards. "The practitioner is not cast as an expert but as an enquirer and co-learner treating his or her practice as provisional and improvable" (McKernan 1996:34).

Lessons in both classes would normally begin with counting rhymes and songs, leading to a whole-class routine consisting of a variety of activities for number concept development. The class would then be divided into three or four groups, each with its own assignment. One of the group activities would be problem solving with the teacher on the carpet. Initially the groups would each get their own set of worksheets or individual assignments. These gradually changed to include pair work, mathematical games, measurement activities and assignments that involved all members of the small group. Although they had appointed group leaders, the teachers tried

during the first few lessons to distribute all the materials themselves and to keep good order and discipline in all the groups. This practice led to time wasted and learners waiting to be 'spoon-fed'. As the lessons became more learner-centred, learners were allowed more opportunities to think for themselves and to take more responsibilities. Discipline, however, remained an irritation for both the teachers, regardless of whether they took full responsibility or let leaders assist them. They found it difficult to focus on the problem solving activity while there was a 'working noise' around them.

Within this series of cycles of acting, observing, reflecting and planning we focused on the goals of the research as key issues, but some other interesting issues also emerged from this action research study. Following is a summative discussion of these issues as experienced by the research participants.

Key Issues of the Research Study

The primary patterns and emerging issues in the collected data were coded and then reduced and categorised in tables. Data analysis and interpretation worked together in the construction of meaning (Ely *et al.* 1997, Lotz 1996, Miles & Huberman 1994). In his discussion on *Analysing action research data* James McKernan (1996:226) contends:

> A good part of analysis ... is concerned with mapping out distributions, and with constructing tables and frequencies. The notion is that a 'statistical description' rather than a strict 'analysis' would be more appropriate here ... Here one tries to get the larger picture in focus by assembling the various indicators and themes into a more self-explanatory set of relationships – a model of the research data.

Solving Mathematical Problems

For Broekman (2000), problem solving is not equal to applying acquired knowledge. He argues that problem solving and problem posing go hand in hand, and reflection on the process is helpful in becoming a better problem solver. Cox and Lewis (2002:1) say: "Mathematics is much more than a collection of concepts and skills; it is a way of approaching new challenges through investigating, reasoning, visualising and problem solving with the goal of communicating the relationships observed and problems solved to others". Murray *et al.* (1998:171) and Du Toit (1994:1.1) confirm these arguments. They regard problem solving as the main 'vehicle' for learning Mathematics. The grade one mathematics syllabus (MBESC 1996:4) states as *Basic Competencies* for problem solving:

> To fulfill the objective for problem solving strategies learners will apply a variety of strategies such as using concrete objects; acting out; diagramming; organising the approach into appropriate steps and sequences; discuss and share ideas in small groups; explain the method used verbally and in writing (or using a drawing) to the group; attend to other learners' explanations of their methods; compare different methods for the same problem; identify errors they may have made; etc.

In this focus area of the research study, the progress of the teachers was slower than in other areas of Mathematics teaching. Taking into consideration the multiple facets of the problem solving activity, where the teachers had been at the beginning of the project and the limited time we had to spend together for the study, it was understandable. The very first classroom observations of problem solving revealed the teachers posing problems step-by-step (in a too high number range for the learners at that stage), demonstrating every step with counters for the learners to follow and copy, and then simply expecting the learners to provide the correct answers. The teachers would then write the numerals on the chalkboards themselves. Further, they only worked with addition and subtraction and did not include problems of sharing (division) or grouping (multiplication) as computational methods.

Analysing the syllabus requirements in our first workshop session, the teachers took the process of change one step at a time. They started to coach the learners to listen to a whole story; then to think for themselves to find possible solutions to the problem; to record on paper (with the aid of counters if they wished to) their chosen strategies for solving the problem; and then to explain verbally to the small group, demonstrating their methods on the chalkboard. (At this stage it would usually be expected of a grade one learners to use drawings and label these with numbers. Gradually the symbols for computation would be introduced and used in sums to accompany the drawings.) This is how far Terese had progressed with problem solving. Learners were comfortable with the process and were ready to move on to the last two steps, viz. comparing different strategies for the same problem and identifying their own errors. Soria, on the other hand, had not established these routines yet, but her learners were already using the symbols for addition and subtraction, and writing sums to accompany drawings. Neither of the teachers had ventured into problem solving as collaborative pair or small group work at that stage.

Although as a child Terese did not like Mathematics and experienced problem solving as having to rush against a time limit without the use of concrete materials, she demonstrated a wide perspective of the role that problem solving plays in everyday community life. For Soria problem solving had not been part of her Mathematics education as a child and she experienced problem solving in community life mainly on the level of helping people to share or divide things, to count

and how to use money properly. Soria and Terese spontaneously agreed with the claims of Murray *et al.* (1998) and Du Toit (1994) that problem solving is the main vehicle in learning mathematical concepts. Soria wrote: "Problem solving make [*sic*] Maths easy for the learners. It is like a guideline of Maths" (17 June 2003). Terese argued: "I feel that a child will do better in problem solving if he [*sic*] developed a good number concept" (17 June 2003).

Learner-centred Education (LCE) and Group Work: Teachers teach and learn and learners learn and teach

With Independence Namibia has committed itself to the Social Constructivist epistemology with "learner centred education as a philosophy rather than a methodology" (Parsons 2001:10). Parsons claims learner-centred education to be:

> ...a starting point from which every aspect a [*sic*] teaching and learning develops. It is firmly rooted in constructivist theories of learning and epistemology that sees knowledge as constructed by the individual based on his/her previous experiences and developed through interaction with peers, teachers and recognised bodies of knowledge (*ibid.*).

Five key principles of LCE are listed in the policy *Toward Education for All* (MEC 1993:60): 1) The starting point is the learners' existing knowledge, skills, interests and understanding, derived from previous experience in and out of school. 2) The natural curiosity and eagerness to learn and investigate and to make sense in a widening world must be encouraged by challenging and meaningful tasks. 3) Learners' perspective needs should be appreciated and considered. 4) Learners should be empowered to think and take responsibility for their own and one another's learning. 5) Learners should be involved as partners in, rather than receivers of, educational growth.

As discussed earlier the two teachers made a remarkable transition from mostly teacher-centred to mostly learner-centred education. Observing themselves in action on the video for the first time made them aware of how much they had tried to do themselves and how little they had actively involved the learners in the lessons. They immediately started changing their habits. The table below reveals the growth and development in this area based on the teachers' reflections at various intervals.

	Soria	Terese
25 March 2003	I have to talk less and the learners more ... let the learners get more involved in the lesson. I must also concentrate on learner-centred lessons ... choose the leaders in a group to give out the materials.	Overall I gave too little chance for learner involvement. [I should] use group leaders for organizational activities.
2 April 2003	I could see how they are helping each other.	I've tried not to say the answers, to lead them too much. I tried to let them think.
22 April 2003	They listen what I expect of them to do in different groups and they remember what to do.	I improved a lot on pair work and small group work and I improved in helping my children to talk to each other.
10 June 2003	I use the kids to do some of the activities, explaining. The girl who came to explain the worksheet, she did well. The measurement tapes we made self. I think I did learner-centred teaching.	All the activities were learner-centred, but during my asking of questions I could still be more learner-centred. [She explains her realisation of the value of mixed-ability grouping as a means of peer teaching.]
17 June 2003	I learned how to ask questions on different levels. [She explains her understanding of teaching learner-centred lessons with different activities and how to do cross-curricular integration.]	I will always remember in all subjects that learners have to 'do it themselves' as far as possible and they must 'think for themselves' as far as possible. Before the research I did not approach my work from that perspective. During such lessons learners will not get the chance to lose concentration and they will learn more and more effectively and they will enjoy it.

The Learning Process: Imposed teaching or negotiated learning?

Namibian education emerged from a closed-system Behaviourist philosophy, which resulted in a hegemonic view of curriculum. The teachers' focus was on packaging and delivering content within a 'fixed' curriculum. Learning was seen as the hierarchical transfer of knowledge, a clear distinction between comprehension and application (Prawat 1992).

> Social constructivism is a particularly strong proponent of discovery learning, in the sense that learners construct their own knowledge through the discovery of meaning and in learning to make sense of their world through their conceptual development (Van Harmelen, in Sguazzin and Van Graan 1998:33).

The paradigms within which the two teachers had been trained are clearly reflected in their views of the learning process. Although very vague, Soria connected learning with understanding: "I still have to strive to see that the learners understand what I've taught them" (1 April 2003). She also argued that the learning process is to take learners "from the known to the unknown ... from his [*sic*] environment to the school environment" (17 June 2003). Terese pertinently related the learning process with knowing work by heart, learners absorbing what the teacher is teaching, copying information in their heads, learning through repetition (7 March, 1 April, 17 June 2003).

She was strongly convinced that rote learning should be part of Mathematics learning, especially in helping learners with a language backlog. The teacher should drill work in "creative ways" and not just a senseless repetition by the whole class (22 April 2003).

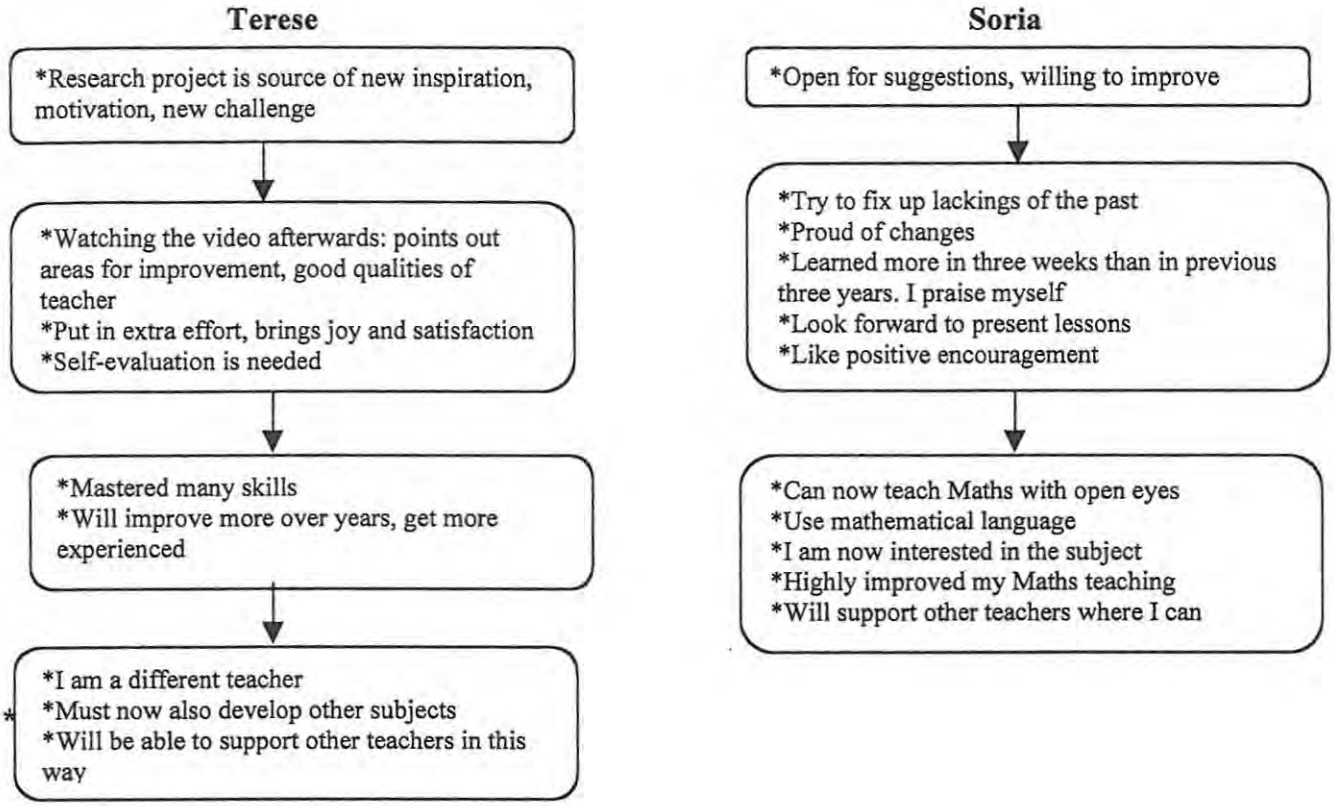
There are those mathematicians who firmly agree with the inclusion of traditional memorisation of multiplication tables, addition combinations and structured methods of computation. Van Oers (2001), Murray (1998) and Ernest (1997) argue that there is a place for some rote practise and 'sums'. Learners need to know number facts and multiplication tables fluently so they can access them instantly for solving problems and applications. Learners also need to know the multiple interconnections between numbers and number facts in order to use them properly, and these are best learned by exploring number patterns, as well as through practice and reinforcement (Ernest 1997). "Children need those solid math skills before they can truly connect math concepts" (Murray 1998:1).

Professional Development: Teachers must be learners

The Namibian policy expects from its teachers to be both teachers and learners:

> In the process of rethinking our philosophy it is important to recognize that we are all learners. Learning is a lifelong activity – a process not an event. It is not something that happens once and then is over. It is something we do, not something we receive (MEC 1993:11).

Namibian education strives among other goals for quality. An important challenge in improving the quality of education is to ensure that teachers are well prepared for the major responsibilities they carry, and that they develop the expertise and skills that will enable them to stimulate learning. Therefore it is essential that teachers see themselves as contributors to nation building and not just simply workers who carry information between curriculum experts and learners (MEC 1993). Both of the research participants demonstrated growth and development in their self-confidence regarding Mathematics teaching and they voiced their views on various occasions. (See the diagram below)



Professional growth

Assessment: What learners should be able to demonstrate

The main purpose of assessment in Basic Education as to develop a reliable picture of each individual learner's progress and level of achievement in relation to *Basic Competencies* as specified in the subject syllabuses, and also to the *Life Skills Competencies* (MBESC 1996, MEC 1993). *The Conceptual Framework for Learner-centred Education* (NIED 2003) emphasises the importance of developing assessment literacy amongst teachers.

Although continuous assessment had been well established in both the classrooms and in all subjects prior to the research, assessment of problem solving in Mathematics focused mostly on the results on paper, i.e. the strategies recorded and the accompanying correct answers. A new dimension developed after we had analysed the basic competencies for problem solving in the syllabus. The two teachers then also considered the other dimensions of the basic competencies for recorded assessment, e.g. learners explaining verbally to the small group their chosen strategies for solving the problem, demonstrating their methods on the chalkboard. They further became aware of the value of peer assessment in small groups and peer checking in pair work for the sake of better learning and better understanding.

5. ANALYSIS OF RESULTS

Mathematics Teaching: Where we have come from makes us the teachers we are

The Broad Curriculum gives high priority to Mathematics teaching, allocating teaching time for more than the equivalent of one school day per week, (plus-minus 22% of school time in the Lower Primary phase). It states that, in the mathematical area of learning, learners should

> ...understand and master a variety of mathematical skills, knowledge, concepts and processes in order to investigate and interpret numerical and spatial relationships and patterns that exist in the world. It helps learners develop conciseness and logical and analytical thinking, and to apply them to other areas of learning and real life (MBESC 1996:15).

It seems as if the paradigms within which the two teachers had been trained are clearly reflected in their approaches to Mathematics teaching. Neither of them had a clear idea of an approach to the teaching of Mathematics when they started teaching in the Lower Primary phase. Although both of them had been using the same teachers' guide as a basis for their lesson presentation, the emphases in their approaches were quite different. A positive point was that both had been teaching most of the mathematical concepts in an integrated way rather than in separate compartments, and this provided a solid basis on which to build the research initiative.

Perceptions of Problem Solving

The traditional view of problem solving has changed. It viewed problem solving as having a closed or a single-answer solution. In order to reach this solution, sufficient information had to be acquired and organised in a specific manner. This view differs totally from the contemporary view of problem solving:

> The Progressivist view is that virtually *all* mathematics should be learned through problem-solving, practical projects and investigational activities. These develop children's autonomy, result in good attitudes, and mean that the basic facts and skills are learned painlessly as an incidental outcome (Ernest 1997:29).

From the interviews and the teachers' respective reflective stories it seems as if the diverse cultural, social and educational backgrounds of the two teachers played a huge role in their views of problem solving. Neither of the participants had much knowledge regarding the syllabus content, which resulted in them not having a clear idea of what the outcomes for problem solving were. This had two basic implications: 1) posing problems only on addition and subtraction and only on an elementary level and 2) unclear assessment criteria. Not being well-prepared for the

day's lesson would then result in adapting the sample problems from the teachers' guide to fit in with the topic of integration without making sure that the level of questioning varied. It is thus important that teachers should take cognizance that " ... a variety of carefully selected and well-formulated problems, based on real-life situations, should be posed on a regular basis" (Du Toit 1994:2.1).

My own understanding of the problem-based approach has also altered through the research project. Learners showed a definite need to have a good basic conceptual understanding of the order, sequence and spatial relationships of numbers in order to solve mathematical problems, while solving problems made it easier for them to understand certain concepts like doubling and halving, computation, measuring activities, etc. We can conclude that, in this case, number concept development and problem solving fed into each other in learning and understanding Mathematics. Terese was convinced that learners would do better in problem solving if they had a good command of number concept (17 June 2003). Murray *et al.* (1998) support this, stating that the problem-based approach requires well-planned number concept activities (including activities that promote the building of number patterns and relationships), well-designed and well-sequenced problems and effective discussions.

Teacher Support: Taking away the crutches when the legs have grown strong

Kemmis and Wilkinson (1998:24) contend that action research is an emancipatory process "...in which people explore the ways in which their practices are shaped and constrained by wider social (cultural, economic and political) structures, and consider whether they can intervene to release themselves from these constraints". Given focused support and the willingness to change from the participants' side, it was evident that positive professional development could occur within a relatively short period of time. It seems as if teachers' eagerness and willingness for professional development lies within their own identification of areas that need polishing or change through reflexive practice. Considering theoretical issues helps then to implement these in their teaching, rather than to be told or trained in ways to change. We saw the 'end' of our research initiative as a new beginning for Terese and Soria with a fresh approach to teaching Mathematics, a change in direction more than the arrival at a destination.

However, teacher support is scarce - both from an understaffed Advisory Service and from school management. Heads of Department, being full-time teachers of over-large classes themselves, struggle to sustain a teacher development programme. This is confirmed in the Presidential

Commission Report of 1999: "Much attention is given to training primary teachers in language skills, but much less attention has been directed to numeracy training (Government of the Republic of Namibia 1999:112).

6. REFLECTIONS

On the basis of the results of this action research case study I can make some suggestions on how to improve problem solving as a component of Mathematics teaching and learning for school beginners, building a secure foundation for conceptual understanding of the subject. The participating teachers in this case study have benefited from planning and presenting Mathematics lessons, observing their own practices, evaluating and reflecting on strengths and weaknesses, devising new plans based on these evaluations as well as on the analysis of theories, implementing these plans, and observing their growth, etc. I am convinced, as they have expressed, that they would be able to support their colleagues in their own school and cluster to develop in the same manner, because the principles for problem solving are the same for the four grades of the Lower Primary phase. If similar development programmes could be supported and guided by Advisory Teachers and Teacher Educators, it could be the beginning of a broader awareness of the problem-based approach to Mathematics teaching, a snowball of professional development and empowerment. A bonus would be that more efficient learner-centred education could be established. This could also have an effect on programme improvement at college level, giving BETD graduates the opportunity of starting their teaching profession with confidence in Mathematics, with a better understanding of teaching approaches.

The implementation of the problem-based approach to Mathematics teaching in Namibian schools could be informed by further research studies to include the other grades of the Foundation phase and on a wider level. This could serve to strengthen practice especially in view of the implementation of the revised curriculum for the Foundation (Lower Primary) phase in the very near future.

7. CONCLUSION

This small-scale action research revealed that through intervention teachers could be supported in the successful implementation of the problem-based approach to Mathematics teaching with an overall improvement in the application of constructivist-oriented learner-centred education in all subject areas. Soria and Terese had felt dissatisfaction about their Mathematics teaching and the

responses of the learners in their classrooms. They were uncertain of the approach to Mathematics teaching and the role of solving mathematical problems within it. Within a busy schedule of normal curricular and extra-curricular activities both committed to the research project and worked collaboratively towards reforming their practice.

Theory and practice are two "interdependent yet complimentary phases" of the action research process (Cohen *et al.* 2000:229). Within a few series of cycles of researching and planning, implementing, observing the action and reflecting on the process, they both experienced the empowerment of professional development. "Reflection, when acted upon, generated powerful transformations" (Etchberger & Shaw 1992:416). This was an emancipatory process that is still continuing.

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9. APPENDICES

Appendix A: Research photos

1. Soria and Terese planning

2. Problem solving in small groups

3. Learner explaining method to group

4. Co-operative small group activities

APPENDIX B: INTERVIEW WITH SORIA: 7 MARCH 2003

Good morning, Soria! Thank you for allowing me the opportunity to briefly interview you in order to get some background information for my study. Tell me, what teacher education or teacher training did you have, and when?
At WCE in Khomasdal. I ended 1999.

So you have been teaching for three years now?
Ah ... it's my fourth year.

OK, and have you taught in the Lower Primary all the time?
Yes.

Ahm ... what methodology or teaching approaches to mathematics have you studied at the college?
Counting (backwards, forwards), group work, problem solving, ahm ... (unclear), abacus, using the counters.

So, they have emphasised the use of concrete materials?
Yes, (*unclear*).

Are you still applying the methods to your mathematics teaching and why or why not?
I'm still applying it, because it's useful and then in my fourth ... these four years (*unclear*) or not to use it, the college method at the school. And I also learn from a colleague at school the method of counting: how to count on from the numbers I give to the kids, like I think maybe: "Count on from ... ah ... three, up to five", now they said: "3 (*pointing to her head, holding up 3 fingers*)... 4, 5". They only count on. This is what method also learned from the colleague.

Instead of counting all?
Yes, instead of counting from one.

Good, ahm ... what do you understand by the concept 'problem solving'?
Problem solving is ... I have to solve the problem of the child. I want a solution from the child. I would give him for example: ... ahm ... "Mary ... Maria, I have three sweets. Now my mother gives me another two. But I don't know how many I do have together". I just want the solution from the child. Now he have to ... ah ... explain it for me that how ... how it's going to get five, whether it's going to be less or more, or ... a ... a correct answer

Ahm ... the last question is ... ah ... do you think problem solving is important in mathematics and where do you place that in your weekly lesson planning or in ... or in your teaching?
I think it's very important, because children learn ... learn more about adding and ...ah ... take away from problem solving. And mostly, at the ... at the end of the mathematic lesson I call the kids in groups on the carpet and do ... individual problem solving with them.

Right, is there anything else that you want to say about mathematics?
Not that much, but I think ...ah ... it's one of the important subjects in ... in Lower Primary, like English ... ah ... language, but still I think it is very important, because it helps the children to use the money properly, how to count, and how to ... to ... to share the sweets or whatever they will have to ... to ... with their friends.

Thank you very much!
Welcome!

APPENDIX C: INTERVIEW WITH TERESE: 7 MARCH 2003

Good morning, Terese!
Good morning (*laughs*).

Thank you for allowing me the opportunity to briefly interview you in order to get some background information for my study. Ahm... What teacher education or teacher training did you have, and when was that?
I had ... ah ... Higher Educational Diploma at Windhoek College of Education and ... ah ... I finished that after four years in 1991.

Was that Lower Primary education?
It was ... ah... diploma in Pre-Primary education.

Oh, and when did you start teaching in the Lower Primary?
I started in ... 1996.

OK, so you are teaching in the lower Primary for about seven, eight years now?
Yes.

OK, and what ...
(disturbance at the door) ...Yeah ...

So, you have taught grade one all these years?
Yes.

Good! And ... ah ... where did you have training in your methodology to mathematics?
I didn't really have training. I only followed a teachers' guide ... ahm ... *Maths for Life.*

Ahm ... did that teachers' guide give you clear guidance on how to teach maths?
Yes, it gave me clear guidance.

Ahm ... if I'm correct, the guide has ... ahm ... lessons worked out ...
Yeah, (*unclear*) ...
So, actually that is my own ... background, ... or my only background.

In fact you did your own ... in-service training.
Yeah, you can say so, yeah.

Do you apply all those methods to your mathematics teaching currently?
Yes.

Ahm ... why ... what do you understand by the concept 'problem solving'?
I understand it's just an ... a very simple, everyday situation ... ah ... where children will need ... ahm ... or what children at this age in grade one need in everyday life to solve, like ... beginning to buy things or when ... ahm ... when things get more or less.

Good, and what role does problem solving play in your mathematics teaching?
... ahm ...

What I mean by this is: ... ahm ... when do you do problem solving in your schedule, in your lesson planning, or ...

Usually I do it as a group activity with a few children and then also sometimes ... ahm ... with the whole group, ... ahm ... using some ... ah ... real objects to help them to see it ... ahm ... 'konkreet' (*laughs*).

OK, concretely.
Yeah. OK.

Right, but ...ah ... problem solving ... if you think about problem solving, is it an application to what they have learnt in ... in mathematics, or will you start teaching new concepts through problem solving?
Ahm ... at this stage still an application. It 's an application. The way we do it, it is an application of ... of ... (*unclear*).

But you also ...
Yeah, no, we also started ... also in the Readiness Programme, we start so that they can understand when do you subtract, or ... or ... add. So you ... it ... it can be that you firstly start with a problem, so they will realise: "I have a problem, so how will I solve it?" So we ... in the Readiness Programme we already started with some problem solving, problems, very simple problems.

Thank you very ...
Before we have started with ... with any ... ahm ...methods.

Yeah. That is in your preparatory mathematics?
Yeah, yeah.

Anything else you want to tell me about maths?
Maths can sometimes get boring (*laughs*), ... ahm ...but maybe it's the teach ... your ... your own fault. Ahm ... in grade one you have to repeat a lot ...and ... I also find difficulties with ... with language. Sometimes they understand the concepts, but they don't understand the ... the words. For sometimes they get confused with more and less, but they do know the concept, but they don't ... they get confused with the words.

Yeah, because the language is foreign?
Yeah.

Good. Anything more?
No (*laughs*).

Thank you very much!

APPENDIX D: REFLECTIONS ON OBSERVED LESSONS (Terese & Soria)

26 MARCH 2003

T: I feel a little bit discouraged, because I feel I want to do something the correct or the perfect way, but there's so many (facets) in a lesson or in your style, or in your interaction with children. It feels impossible for me to do it correctly every day. I make so many small faults, that I don't ... I feel ... that I will need to concentrate such a lot ... to correct me.

Do you think that you are doing things so totally wrongly that it will damage the learners?

T: No, I don't think so.

Is it just a feeling around yourself that you are not doing the best you can?

T: Ja, or the best there is. I would like to see a teacher in practice that's doing it very correctly. It will be interesting for me to see such a person and I want to learn from them.

And the person that you saw on the video yesterday, wasn't that such a teacher – doing the best she can?

T: No, I know. The thing is: I think you are in such a rush throughout your daily routine that you just walk in the class and you start teaching. You don't really concentrate on small things, because teaching in the whole with your extra-murals, with your administration ... there's so many things that you need to concentrate on, that some things do get lost. And I don't like it.

If you look at paper, theory on paper, everything looks perfect. But I can assure you, you will never see a lesson where there is a perfect teacher in the class who does everything by the letter. And I think once we manage to do everything by the letter then we won't be a natural person any more. That's my idea. We can improve on what we are, but we are what we are, and within that, I think, we just do out best, the best we can, the best to our knowledge. There's much more to be learned, and we mustn't let an opportunity go by to learn some more. But what you are doing at this stage is with the present knowledge and the present skills and experience you have. If you are putting in the best you can, then there is that teacher you are talking about, the perfect teacher, because you are doing your utmost best, not on what anybody else knows or what anybody else can do, but what counts for you. So don't be despondent in what you don't do, be positive about the things that you can do and do do in your class. We must be careful, there's a very thin line in our strive towards being better. We can always strive to better, but we mustn't idealise something that is impossible or something perfect out there that I will never be able to reach, never mind how perfect you are, or how good you are, if you want to reach for that 'thing' in the sky, you will never reach a point ...

T: ... Your feet will lift up.

S: I didn't know I look that way on the screen or in front of my kids. It's the first time I saw myself on the screen and I couldn't believe the way I am acting, my facial expression and how the kids are learning from me. But always I am confident. But in my heart or around me, there is a space, a big space for somebody who can come and give me suggestions, improve me, who will come to help me. He or she is welcome to come in. I will never take it as a negative or as an insult, I would just take it as help. Everybody is welcome to see what I'm doing. Ja, I want more help how to improve my presentations.

I'm so glad that I have the two of you, because I think you are very open. That's what I wrote in my reflections last night. I think there's an openness between us, and we don't feel uncomfortable in learning situations, offended by somebody else and that is a big support to me, because we don't have that many days to spend together. If we had to break down barriers first, then it would have been very difficult to come to the research part or to the grow part.

1 APRIL 2003

How do you feel about what happened today?

S: I am excited, but I don't know.

You are excited, but you don't know?

S: I don't know what you're going to say, but from my side, I was confident. Things just came out. Naturally, I didn't ...

T: I don't feel confident at all, but I see that the grade 1 teacher has more difficulties to capture children's attention. I feel that I've lost my children's attention during group work. And I realise that sometimes you think you are teaching, but you are not really teaching. You are busy, but nothing happens and nothing goes into the children, they don't absorb what you are teaching, and I feel like that today. My children didn't absorb much. I did 4 problem-solving sums. I cannot say that I feel that they have grip on it.

The other thing ... I tried to integrate my measuring, I tried to start with a problem, but it wasn't so effective. But I also realise that these children's ... Hulle belewenis van probleme is maar nog baie klein. They didn't face so much problems in life, because they are now beginning to live. So it's difficult to think out problems. I had to think a lot yesterday at home. What can I use? We are actually busy now with class objects. You know, they are supposed to measure the chair and the desk, but I couldn't think of a problem to integrate with my chair. Will my ... fit or not? Will my books fit, or even my pencil? I couldn't think of a problem to use, that's why I went over to ... And I didn't use real objects, but I also thought it may be wrong, but it was difficult for me to hand out real objects also, so ... And I couldn't think of a problem to start with.

S: I think the children on the carpet ... I introduced a new counting object, those sticks. I didn't use the old ones. And they were excited. The moment I hand it out, they started making their own things, play on the carpet. After play we started the problem solving, and after the problem solving I gave them free playtime to make or build whatever they want. And I could say they came out with a beautiful what ... beautiful creative ... I could even see that most of them didn't copy from each other.

T: What happened with that one task of mine where I gave them the words, one, two, three, four. They had problems there, because one of them cut a wheat-bix picture in two, ... (when they couldn't find pictures) and they just cut up strips to make 5.

As long as they have the sense of the number. I hope that is part of what you read in that paper ... the 'numerosity. And that is what we are working towards. As long as they have that number sense, that is fine.

How do you feel at this stage about your own development?

S: I think I gained more knowledge or improvement in my problem solving. I know now what is going on and how to deal with the groups, and how to cover the whole group first and to divide them into groups, which I didn't do most before. Now I can do that every time. I can even see the children settle down in groups. They know when I even talk about groups, they know they just have to go to that group or whatever. They are excited

And if you think ... it's only their twelfth week of school, and they already know about group work.

S: And they know something about problem solving In lesson 1, in Unit 1, they already deal with that.

T: Ja, because there's somebody in your class watching you, you are concentrating and it's already a good start. Jy begin nie so slapperig nie, jy begin sommer lekker.

S: But even if somebody is not in your class, in your mind you imagine somebody is behind you without, even if your body is absent or whatever, you are still there. But every time I'm giving a lesson, I think you are standing there.

But do you know what is that imaginary person's name? Responsibility. You are being aware of your own responsibility towards your learners, and that is what makes us try harder and do better and so on, because you are constantly aware of those children in front of you that you are responsible for.

S: And the lackings in the past, I'm trying to fix that up now.

So, you feel stronger in organising group work and in problem solving, if I heard you correctly?

Do you think there's a little improvement in your teaching already?

T: Ja.

In what sense?

T: In concentrating on the children, more than concentrating on the lesson I must teach.

OK. Ja, that's something that you also said last time: that you tend to concentrate so much on the lesson that small things slip. So, are you becoming more aware of these little things in class, the children?

T: Ja, and another thing is, that I want to remember for the rest of my life is to teach fewer things, fewer aspects, but to teach them thoroughly. (Agreement Soria)

<u>2 APRIL 2003</u>

S: I'm not that satisfied with my lesson. I think I made a lot of mistakes. Mostly with problem solving on the carpet. I was just confused.

Today, you felt confused? Do you know why? (Silence) Do you have an idea why?

S: I don't know.

You don't know?

S: I forgot! I forgot something I should have learned them during the whole class lesson. In my preparation I should have asked one child from the group to count all the chairs, and another child the desks, but I forgot that. I felt very bad.

OK, but that's something that you can do tomorrow. So, that's not a major issue, because every day you have new activities to start your lesson with. So, if you forget it today, you simply do it tomorrow.

S: I even forgot to let the learners fold the papers and I didn't even show them where to start. I should have told them to start in the top left corner. I didn't do that.

But if you look at your lesson today, do you think there was some learning?

S: Yes. But maybe my bad feeling is only when I divided into groups, but overall the lesson together as a group, I think there was some new methods, something new I brought in...

OK, anything else? Terese?

T: I don't feel anything. I can't really say. I don't feel good and I don't feel bad. I also forgot a lot of things, but I also remembered a few things. Learning took place, learning could have took place better ... One thing that bothers me is the discipline in the class. It bothers me a lot. If I cannot concentrate on the group, then I start to get irritated. That's a big thing.

OK, I'm going to ask you 2 things now: How do you feel about today in relation to yesterday? You don't feel very good about your lesson of today, but do you think you have applied something new with success?

S: Of course, of course, of course!

OK, what was that?

S: The hungry monster...

The children enjoyed that very much.

S: The way that they were listening attentively. I lowered my voice and I told them the story, and when the monster grab, then I make a little bit higher sound. And I could even see from the children, they just wanted to see where it's going, when it's going to grab the thing. That's the part I enjoyed the most. The whole lesson on the carpet together with the children, I enjoyed that all the way through, the group activity.

And your new position on the carpet, did it help?

S: A lot, a lot!

And the 100 chart?

S: 100 chart, of course! It's the first time we use it close to the ... and everybody wanted to go and show the numbers. And my weak child could even tell me the number before 10, which I didn't expect from her.

Good! And Terese, if you think about yesterday, is there some area that you feel you have improved today?

T: I've tried not to say the answers before, to lead them too much. It's not so much successful yet, because I have to practise it. And then I've tried pair work, that could have also been more successful, but it's the first time that I've tried it in that way.

And the learners must also get used to it. It's something that they also must get practice in.

T: It was very noisy, but I left them to do it in that way.

It was a busy noise. It wasn't a...

S: ... sharing...

Ja there's a difference between a busy noise, talking about what they are doing and just taking over the classroom.

T: They were busy. Ja, that's a new thing I tried.

S: I applied that containers to put between them and they did very well. And I let them use the thick pencil, which I could see from far what they are writing and whatever. And the pair group work there were two peers working together, I could see even, while they were supposed to paste seven pieces of seven what, and the friend start counting again and it was only six, so I have to put another one.

You see, they check one another.

S: They were not allowed to talk. As you said, it was a busy noise. I could see from the carpet how they are helping each other. They didn't make a loud noise.

T: I tried to let them think. Even if it's not so successful, it won't be every day so successful, because you won't have so much examples, but at least I'm trying to say something and let them first think about it.

Give them time. The children get used to their teacher telling them all the time, they don't need to think. So, they must also get into the habit of: 'She's really expecting me to think now. She's not going to give the answer, we must think'.

T: I think you will later get used to questions that you can ask. That age of children, their level ... They came up with the correct answers.

Look at the rhyming activity, how much better it was today.

T: And I was asking them how will I know what they need in their boxes, and they came up with the correct answers. It took a while.

Yes, yes! If you just lead them: 'Can you think of another way, another way, something else. Then they will come up with what you are expecting from them.

S: And I also asked my children 'How many chicks did the hungry monster eat?' First he was eating 3 and then 6, which was really a big number for whatever. And the two boys, the other one held 3 fingers up and the other one 6 fingers and they could count together.

But if you stop them there, if you stop this co-operation, then none of them will be able to solve this problem. That's incidental pair work. It's so natural that children come together to solve their problems and to organise them.

What do you feel inside at this stage (just an overall view)? Is this worthless or worthwhile? Are we going somewhere or are we wasting our time? It is very important that I know it now, because we are halfway now.

S: No, I feel very good. I'm proud of myself, the changes I have made in my class with mathematics concerning problem solving. I'm feeling something is happening in my class as well as with me. I mostly use also mathematical language. Things are just coming out from nature or ...

Ja, it becomes natural.

T: Anything that you do that you try to improve on or where you put a little effort in brings satisfaction, and that brings joy in your work. That's why I was from the start very excited about this, because I know if you put a little bit effort and give attention to something, you see improvement, it gives you work satisfaction. And I feel work satisfaction. At the end of such a lesson you feel 'Wow! Today I have at least done something worthwhile.

You are gaining something?

T: Ja.

It's crucial that we decide upon it now, because we are halfway now, and there is so much more to do until we reach, I hope not the end, but the beginning of a new you. If we are not on the right track, then we should start looking deeply into what we are doing, and are we going to change now.

The last question: With what are you struggling the most at this stage? What do you not feel good about?

S: The questions of problem solving. Appropriate questions to the learners according to their level.

Anything else?

S: Not that I am aware of.

T: I also feel that the way of questioning, to ask a question so that they understand what to do exactly.

S: Appropriate questions to see do they understand or is it something well known to their environment.

T: Then I would really like to have the ability to teach children things so that they know it. They must know it. When I'm done with them, they must know it, even if I have to repeat it again, I want to get maximum learning in one period.

That is something that we are moving towards. I think what you mean here is deeper understanding, that they don't just take something, but they really understand what it is about.

T: Very effective teaching. And I feel a lack in that in grade one, also with the other subjects, like reading for instance.

And if you reach the last two weeks of the year, do you still have the same feeling?

T: I have that feeling all year, then I have it, then I really have it. Because then most of your children can read and can do sums?

T: No, not to the standard that they are supposed to.

Supposed to or what you are expecting them to?

T: Supposed to.

22 APRIL 2003

S: I don't feel quite well, because after a long weekend it's always difficult to present a good lesson.

Is it because you were not prepared?

S: NO! I was prepared, but after a long weekend we didn't settle down and many wrong things can happen. The kids are also noisy and they want to talk about what they have done, where they have been for the long weekend. So we have got ... to finish on the first day after a long weekend. That's why I think my lesson was not what I wanted. Many things went wrong according to how I observed myself.

T: It didn't went so well, but it's not so bad. The only thing that bothers me was discipline. It was a major thing. I think it was because I had two activities where they had to talk to each other. It bothered me a lot while I was doing problem solving.

Anything specifically on the positive side? Because both of you have talked about negative things now. How do you feel about your growth – something positive? I left you alone for three weeks now. How do you feel about your growth during this time?

S: There were improvement. I settled down with my problem solving. Even the kids are used to, after the lesson they are now used to be in groups and those who settle down, they know what they are going to do on the carpet, for what reason they are on the carpet, and the others, they have to do different tasks. They listen what I expect of them to do in different groups and they remember what to do. According to myself I settled down with problem solving. Comparing with in these 3 years I was teaching here and ... how many weeks

In 3 weeks you learned more...

S: Absolutely more. I can praise myself and thank you.

T: I think I improved a lot on pair work and small group work, and I improved in helping my children to talk to each other or to talk about their work. That's the main things.

So, you could definitely practice the things we discussed during the weeks that I left you alone?

T: More learner-centred. (Soria confirms)

Now another question: Are you able to apply these principles also to your other subjects, or do you only use them in mathematics?

S: If you use integration in ... method, mathematics is integrated with other subjects, it will work. Sometimes that you leave out or forget to maybe environment. Like me, with problem solving, I should have used one of the communication methods, but I didn't even introduce communication as ... of the environment. It would be strange for them to use cellphones, why I was using that one. But if I should introduce before I should have applied in mathematics which brings two different subjects together and mathematics as well.

But can you apply for instance your group activities in Language as well? Do you use these principles in Language lessons, also to divide them into groups?

S: Yes!

T: You can use especially the pair work and peer assessment and the group work where the children work together on things. We do use it to divide our reading groups. When you have a group with you the others are busy with games or pair work.

Have you tried it in Arts and Environmental Studies?

T: I have tried it in Arts, also the rotation of groups, especially when you want to paint, then it's easier for a small group and tomorrow you swap them for ... Ja, and I sometimes use the subjects together to make my groups, because you don't have so much work. So I will use maybe a language activity with an Arts activity and even then whatever other subject.

S: One good thing I came out with this small group work, I used it in reading in English, and I divide my class into small groups. I call out one small group and the ones who are sitting at the desks, they have to judge which group did read the best in all of them, in which group did all the learners read and in which group did most of them not read or whatever. Now ... they sit and listen, they have to judge, they have to help me who's going to do the best. And at the end I give a reward like a stamp on their head, and they feel so proud. And now everybody is wanting to be the winner...

That's the beginning of peer assessment, assessing one another, and also reflecting on yourself. In the beginning, when you start with such an activity, you will find that the children nominate themselves. But that is where criteria comes in. Before you have such an activity you must tell the children what to look out for, and really judge according to those criteria. So, criteria are very, very important. In judging, for yourself as well, for assessment, you must decide beforehand what your criteria are. And use the learners' criteria. Share assessment with them. Let them take responsibility. Of course it's just making them aware of personal, critical reflection on what they have done themselves, and then also to judge others according to criteria.

T: I don't know whether my 4 groups worked well, but there are some problems with it. Sometimes if you miss only one day, then it is gone, you cannot catch up. Instead of three groups you have two days to catch up. Then you have to announce new leaders, while the other 3 groups already have their leaders, and then you have to explain so many activities beforehand. It gives a little bit more discipline problems.

It's something that you must try out later in the year, so that the learners can get used to group work in the first instance, and that they also learn better how to organise themselves and that they take responsibility for their own discipline. So, it might be good in the beginning, now, to work with only 2 or 3 groups and then gradually increase your number of groups.

T: I was also wondering... (It's now way off the...) these activities with the games and these activities that are so noisy, isn't it possible to do your 3 groups with the noisy items, and then you have one activity each day that keeps them very quiet, then you get out only your problem solving, because I feel as if I'm losing the children.

There must always be a balance in your group activities. You will always have one activity where there is individual work, like a worksheet or something. They will be quiet, or they must be quiet. They are expected to be quiet. Then you will have one pair group or small group activity where there will be a little bit of noise, or a game. I will come back to games later, but all your games must be learning activities.

T: But I'm talking about ... I don't know whether you remember how we did the sentence building? We had one activity and that's the creative writing, and then you call out only a small group, and you work only with them on the carpet. Now I was thinking: because I am a kind of person who wants silence, maybe if I can do the other activities, the 3 noisy ones, then I don't worry about the noise. They can go on with that. But for my problem solving did one activity each day and just take my problem-solving group.

Oh, ja, I understand what you mean now. You will only have 2 activities and the children will only sit and do worksheets?

T: They will maybe do a worksheet or something that keep them very busy. And I will call out only that group for a day, only let's say 9, for 4 days, and I work with them and they go back and also do the worksheet.

Maybe take them over 2 days and take 2 groups per day.

T: The noisiness bothers me.

That's a personal thing. Either you get used to it, of one group being a little bit noisy, because I don't think that they were noisy at all today. It's also a matter of the learners getting used to working and behaving and taking responsibility. I would say come away from this. If you have a more-structured assessment or something that you must really concentrate on, then you could do it. But I won't do it as a rule, no. I would pick two different rotational activities.

23 APRIL 2003

I only have compliments today. I hope that you feel the same. Everything that we discussed yesterday, you have taken care of today. I was very, very impressed with the lessons, except for that Mother that bothered us.

(Unfortunately the rest for the day was not audiotaped)

10 JUNE 2003

T: The only thing for me was discipline. That was the main thing that bothered me. Maybe not so much discipline problems, but I have to ... that I have a very active class. And then, maybe if I change that one activity, then ...

OK, should we look at part of your lesson before you reflect, or how do you feel about today's lesson?

T: The part where they were working with water. I couldn't find ... I try my best, but ... in mind also to label the containers they are going to use, to label and tell this is number one, you put next to number one how many cups you put in. It was in my mind to do that, to label and put up somewhere that they can see number one is for cooldrink bottle, number two is for ice-cream container. So, they measure number one ... as a pair. Discipline ... they were over-excited about it. They are used to the camera, but I don't know ... they want to be seen on the screen or whatever.

But it's fine, it doesn't bother me, because I focus more on you, because you are my research subject. I don't focus that much on the learners.

T: It bothers me.

Ja, because you want their attention, that's true.

T: I thought for 3 hours about a problem that was on the children's level ... and in the end I ended up with something from the kitchen. It's not so much on the children's level, but I couldn't think of something else...

You wanted to have a connection to their real life situation, and then you told them about their mother's problem. Do you think this was a successful introduction? Do you think you got the connection?

T: I don't think so.

Why not?

T: Because at the end they forgot about the...

But why concentrating about the end ...for that activity ... did you make the connection?

T: Although I would like it to go through the whole lesson. Why are we now weighing here in a group? Why are we using these scales now?

OK, your connection for the learners to the real life situation worked well, but you don't feel that the connection with the rest of the activity was very good? Am I correct? (She confirms)

S: I think the rhyme ... this is the first time ... I want to surprise them with something new. I was happy about the way they coped, the way they say it after me or together, I don't know how successful it was.

How do you feel, how successful was your new rhyme?

S: The children enjoyed it. From my side I think it was worth it, but I don't know how you ... They could tell me whether the boys get more or less every time they are jumping off and broke their legs. I think it was a good introduction for number 5.

I think the learners enjoyed it, and I think I enjoyed it when I went back to the carpet, the whole group, and they were still limping.

Anything else in your lessons that you felt very good about, or that you didn't feel that good about?
S: The girl who came to explain the worksheet, she did well. I could see that everybody understand. The learners on the carpet should listen attentively to the one who is explaining. I even pretend that I'm a learner to ... The measurement tapes, the blue papers we made self. They enjoyed; they could measure most things on the paper. Maybe the ones with the water also enjoyed, but it was not that well done, not structured...
You didn't structure it very well. And the activity itself, was it successful? The water activity? The measurement? For the learners?
S: they estimate the numbers of the cups and we put on the chalkboard. And when we go over their highest number (Their highest number was number 7) and then the cups went over to 14. They couldn't believe, so many cups go into that small container. It was something new and something unexpected.
But it's good that they start estimating now, because later on it will be much better. Their feeling for reality will become better. What do you think what is the purpose of estimating or guessing? What could you do with their guesses?
S: Afterwards we should have come on the carpet and we should have take the papers and the most numbers that are almost the same, we should have take that number of the chalkboard and say maybe the 14, most of them were having 14, we should have write it on the chalkboard and say 14 cups fill up this container. Then everybody can know.
Another idea? Terese, could you help here? What could you do with your estimations or your guesses?
T: I didn't really listen to her now. What you can do, is you can ask which number is more, which number is less ... how far were you out?
S: How many should you add to go to that number?
This will be very difficult for them at this stage.
S: If we do the method we are doing it. We said we have 7 here, and they only count on.
And then you could have come to doubling, so it was double the number...
I want you to reflect on today's lesson regarding LCE.
S: I think I use the kids to do some of the activities, explaining. I think I did LC teaching.
Does it come natural to you now?
S: Yes, I wasn't even aware. The ideas are just coming from self like come and show me 14 on the chalkboard, it's something I didn't plan before. It's just coming through the ... while I did it
Instead of you showing it, you call a child to do that. And you, Terese?
T: Well, the activities was all LC, but during my asking of questions I could still be more LC, especially through the introduction part.
But you also called in learners to demonstrate everything. You didn't demonstrate, except where it is necessary, where you saw that the learners weren't understanding how to handle the balances, how to steady them down, or what they should do with each of those items. There you did the demonstration, which was correct, otherwise they wouldn't have understood.
I think we should look at the first lessons again, where you did everything. You did all the demonstrations, all the pointing out on the 100-block...
T: And I even said the answers.
Correct! But now you let the learners do everything. You did group work, so the learners were involved in all the activities, but with your whole-class activities and your demonstrations you totally moved away from 'teacher does everything' to 'let learners do everything'.
Anything else that you want to reflect on, anything that made you feel unhappy about your lesson, except for the discipline?
S: ... the worksheet. I didn't do it properly.
T: I sometimes assume that learners know something, that they will realise something, I sometimes neglect to explain things step-by-step, and that's what happened with the scales. At first I thought that it was so logic and they didn't know.
A WOW! moment? Anything in your lesson that you felt very good about?
T: I feel good about my scales, because it was something I thought of, I made it over the weekend and I think it works all right.
And it's something that can be used for years and years.
T: Ja, it will stay there in the room.
And you, Soria?
S: not that much. I don't know which part was excellent, but maybe the one with the naughty boys of grade 1C.
Don't you feel good about your whole lesson today?
S: not actually. I think I made some mistakes, because of this discipline part and because it was after a long holiday. The kids are not settling down.
T: I really think that after 12 years I could teach!
BIRGITTA: It seems that you have changed since March from teacher-centred to learner-centred. The discipline problems come while you're getting the learners more free ...(T: Not an excuse), because you leave them to creativity (S: on their own)
T: If they are working in one group, you are in front, then it's much easier to have discipline
S: the group work is a noisy...
But what is discipline? Does discipline actually mean that everybody should be quiet?

: Not actually, but you can see the moment the child is not concentrating, they start beating each other. It others me a lot if a child is doing that.

'hat is something that should be addressed.

'erese, if you reflect on your activities of today, what would you have done differently?

[: I would change the one game to a silent one, to individual work. And I would have explained more before I tarted with the balance, because there they needed my help and those on the carpet were waiting for me, and hey started to get noisy again. These are the two main things I would have changed.

Soria, what would you have done differently in your lesson if you could start it all over again? The water activity?

S: The children understand the activity, but on the paper it was not that clear for them. I should have paste maybe the pictures or whatever.

Now tomorrow, what I want is you to demonstrate to me your growth, to be the person that you have become, the mathematics person.

S: It is very difficult.

Very difficult, why?

S: Yes, it's very difficult.

T: I'll just do what I do. What else can I do?

That's what I want. That's exactly what I want!

S: I was wondering how am I going to stand in front of the ... what method must I...

No, no, you do exactly what you did today, because that is the person that you have become, but try to cut out the parts that you know didn't work today. You should start from now on, now is the right time to work in 4 groups. Why are you so scared of 4 groups?

T: I worked until the end of last term in 4 groups. I changed the last few lessons, but I really don't like it...

No, it's really up to you, but working in 4 groups makes your problem-solving group smaller, you will have much more control, seeing what they are doing...

T: Maybe if you could just swap your children so that you have the clever ... (mixed-ability groups) **that there's a few in the group that knows, that you don't have to ... because my one group is weak. If I can change them a little bit, then I don't need to give so much attention.**

But you see, that is actually one of the principles of LCE, to have mixed-ability groups, because they do peer teaching and peer learning.

S: They help each other.

They help one another. Especially in such overlarge classes, you cannot teach 36/38 grade one learners to your full potential, so you need your fast learners to help you teach.

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T: After the lesson I had the feeling that this was my best. There was many faults, but I'm prepared well and I practiced it over 2 days and I tried to rectify my faults. So, I feel it was my best, even if it had faults, and even if I forget some things. Maybe after 2 years or 3 years then I could have improved. As you get older, the more experienced you get. But this was my best.

You feel good about your lesson.

T: I feel a little bit discouraged. Not discouraged in a negative way. I feel where will I get time to prepare more thoroughly, so that I can see all the small things that I'm not doing ... I feel a little bit how can I, what can I do to improve more faster.

Do you get the feeling that you want to do more per day? I don't think that is what I understand from you.

T: Small things that I do wrong, I want to get it right. But now I did it in front of the camera and I still hadn't do it right. It just wasn't part of me to do it right. I would like to see a way where I can teach so perfectly, to practice to see it so perfectly that these things don't occur anymore. But I don't see how I will manage, because when you are alone and you prepare just like this previous day ... I'm just scared that I will lose it again, you understand?

Can I tell you a secret? It will never happen, because you don't work with things that you can push over there and later on go fetch it again. You work with people, and where people are involved, especially so many people, there these things will happen. Every day is totally different from the previous day and those things happen. Unexpected things come your way, every lesson, every day and that is quite all right. We as human beings, I think we could never be perfect.

S: Problem solving was not what I expected. It was to say, a mess. I didn't even realise the things which are happening bad, because of the noises I have to pay attention while I concentrate more than I should have been down here on the carpet. But I'm satisfied about the lesson today. The introduction, I try to change it every day if we start with mathematics. We used to sing 1, 2, buckle my shoe, whatever. I thought let me start with something totally new, without their knowledge, kind of surprise, and I start with a brain gym and I could see everybody enjoy it. ... But as I'm a human being, I cannot expect a quality or a lesson without any fault or a lesson without any mistakes. Mistakes happened unexpectedly. Afterwards you realise 'oh, I should have done this' but it's normal. We are just human beings somebody have to take as you are, even in what kind or whatever.

And if you have developed that ability to afterwards think about your lesson and reflect on it, then you will try tomorrow to improve on those things that went wrong. Then other things will happen. That is fine, again. Your whole life is an improvement on the mistakes that you make, keeping in mind that you must always reflect on what you are doing. It doesn't mean that you will reach a point where you are perfect, where every lesson happens perfectly. Even as

a very, very new teacher I had the feeling sometimes that this was a perfect lesson. But then years later you have the same situation, the same lesson and you feel it was a total flop, because you are working with different children every time. I think it's a personal development and as you are working with human beings, that is what bring the surprises.
T: Now what did you do as an experienced teacher, what did you do over the years to develop yourself? Did you sometimes try, (because we don't prepare always in so much detail) did you sometimes just sit back and said 'I will forget about all the other things and I will now prepare maths very good', and then you go back and reflect on yourself and ... What did you do?
I think what is very important is not to land in a ditch, the Afrikaans 'Om nie in 'n groef te beland nie', because many teachers feel safe in the ditch. If they can do year after year the same thing and they don't have to put much effort into it ... I was never like that. It bored me to death if I had to do the same things over and over again.
S: Without any improvement.
Yes. And I think that is what keeps you on one side up to date, and what motivates you to find out new trends. Of course my involvement on a broader spectrum, I think that is also what gave me much experience. And I think you mustn't sit and wait for opportunities to happen in your life. You must, if you are interested in this, make people aware of that. Bied jouself aan. Offer people to help them. Invite other school's teachers who are struggling with something to come and sit in your classroom. Afterwards you can reflect together. It's teacher development on the other part, but it's also personal development. I developed more while I was training other people and you learn from them more than you could ever think.
T: Because it often happens that after a few years you realise 'actually I'm on an island, I am working with others, but I feel as if I am on an island'. You know, we share, but we share old ideas again.
S: What happened is teaching problems it's just something where you can grow in. Every day that something came out from your own mind, your new method. Maybe I, I present a lesson yesterday and I want to improve on that one. The methods come from your own, your new ideas. What can I do that the kids on their level, what can I do that they understand better? And you come out with something new from yourself, not out from the books or somewhere. According to the kids, their level, their background.
And I believe that what started here with this research process, it made you aware that you must think out new ideas all the time. You did it for the sake of the camera, maybe, maybe you did it for my sake, but now it started within yourself, and I feel about this research that there was more personal development inside you or instigated by you. I was only here to facilitate, but there was more personal development from inside yourself than what I could offer you. And I hope this is a process, which will not stop here. I believe, when I look at the two of you, this is what I see: a person who will from now on try to bring in new ideas all the time. I don't know, does this happen in other subjects also?
S: Yes!
T: We give new ideas, that's true, but the perfection of classroom management, that doesn't improve so much. I have many new ideas I use every time, but the way of organising a thing. Maybe also the maths, the detail like listening to a kid, that small insight, that something ... It feels for me that I'm developing too slowly now. I want it to be so much faster that I don't need to prepare so, 6 hours maybe for only maths. I'm sure that you could go in without preparing too much and you could have present the same lesson that I did today, because you have experience, children's' behaviour, body language, that small things. If you say so, they will do this.
No, it's much easier standing on the side and observe what other people are doing, because you are the actor. If I'm in the same situation and you stand on the side, there will be as many things that you could tell me: 'look at that, there you could have changed this'. Because you have the ideas in your head and you have the knowledge and you have the experience. But when you work with human beings it's not that easy. And you must think on your feet all the time, even if you are very well prepared. Everybody can see that both of you are well prepared. That is what Birgitta also said, you are so well prepared, but it isn't necessary to spend 3 hours or more on a single lesson. If you spend that much time on a weekly lesson, fine! Because then you have thought through your problems, you have thought through your activities for the week. But once you start planning in this manner, you will see every week it goes faster and faster. And if you do your language lessons in the same manner, then you will have as much success in your language lessons as in you mathematics lessons. I like this word *internalising*. It becomes so part of you that you don't have to constantly think about it all the time. You have internalised it. And that only happens with practise, with experience. So, once you have internalised it ... And it's the same with the learners, what we said today, look how easy it is for them now. I'm sure if I showed you the first lessons that we videotaped; you will be surprised, on classroom management level, how much you have improved.
S: I don't know whether I'm on the right track or not, but before I present or I start with my class or lesson or whatever ... I'm such a person which I don't like to prepare. I never make a lesson ... I will maybe only write two sentences for my whole lesson. But as I start with a lesson ... even these things I'm doing, I never prepared on the paper. Once I start something, things are just coming on itself. It's not something I sit down and whatever. Like the water that day, the first day I start with the measuring, I just get an idea. I went in my storeroom, 'what can I use?' Then I put these, I take these. Something just happened, I don't need ... I never write a lesson out, what am I going to do. In English I start with that things I ...I don't know whether I'm on the right track or not, but if somebody come and ask me your weekly lesson preparation, whatever, I don't have it. But if you come and listen to my lesson, it maybe sound like I make a preparation or whatever.
T: I need to prepare in detail. I have to think 'what will I say?' I have to do it. 'How will I ask a question?' I need ... it doesn't come naturally.
The danger in that is ... (I think everybody can teach in that manner, any teacher). The danger in that lies in that you will maybe run out of ideas. You won't have that many new ideas, because say for instance you keep a book and you

write down all your ideas only on number concept: different activities, different things you can do, the list will be added to every year. But if you don't plan them or write them down, you will run out of ideas or you will always come back to the 20 or 30 ideas you have. It is when you really plan that new and interesting things happen. Another danger that lies in it is that you may come to the end of the year, and you may realize "I haven't done everything that the syllabus requires from me. When you do your group planning as a grade one group, it isn't in that much detail. You just touch the topics. We're doing this topic and that topic, but the detail is up to you. And you might come to the end of the year and suddenly realize, 'That teacher's children can perform much better numerically or in literacy than mine. What is the matter? We taught the same content?' It's just those little things, the detail, that ... I could also teach like that, and I did, many times. When I didn't have the time to prepare for the week ahead, as long as I know what my topics are, I could teach for a whole week without doing any...

T: But one day that you don't feel so good, you can teach if you feel good, you can perform. But that one day when you don't feel so good

S: But after the lesson I come back to the what, teacher's guide, and see which didn't I...

OK, if you have a teacher's guide, that is your guideline, then it is already written down for you, that's fine.

S: ... what I missed out and I have to put in another day.

Ja, but if you didn't have that teacher's guide, you couldn't have taught without preparation. Anything else?

S: I want to say to Terese, my colleague, according to my observation for her through this, she totally underestimate herself, which is wrong for me. She doesn't realise that she's a human being of say yes, accuse herself always.

T: You are reading me wrong. I know myself, and I know people read me wrong. But there's one thing, I once read it and I saw myself in that. If a person don't know me well, then the person will think I'm just writing myself down and that's not true. I heard a saying that said: 'Teach your children to touch the clouds, at least their feet will lift up'. I know I cannot reach the clouds, but at least my feet will lift up. I don't know if you understand what I'm saying. I will rather see my faults and try to improve, but I don't think that less of myself.

S: But according to your reflections, always, even such a good lesson I see on the screen. You did so well, but your reflections are always negative on yourself.

T: I don't feel bad about my lesson, but if I feel good now, 'OK, I'm now fine, I have arrived'. I don't want to arrive. Sorry I have to bring it in with religion, I was learned that through my religion. You never arrived. I'm not OK, I'm not good in myself and I'm not doing everything right. I'm not a little angel. It's just that way of self-introspection, always doing introspection. But I know I'm a good teacher, and if a parent come to me and they are complaining because children are failing, then I know I'm a good teacher. And I said that to Mr Titus and some of the parents: 'I'm a good teacher".

S: I'm happy to hear that, Terese, it's the first time I hear that.

T: No, if it comes at the right moment I will say: 'I am working hard'. No one can tell me I'm not working hard, because I'm working hard. And I know I'm trying my best. That's why I also said that's my best for now.

The way that I read you is, you don't lack self-confidence. You are confident about your qualities and what you can do well, but you cannot rest in the little mistakes that you make, that you always strive to be better, that you always strive to be perfect (that's the word that you use many times). I want to use the term 'You want to strive for excellence'. You don't just want to be a good teacher; you want to be an excellent teacher.

T: And you will die. If I just say 'ah, I'm OK' then I'm not alive any more. Then I'll go home and make food and just float on. It doesn't bring inner peace and joy.

There are many people who are satisfied with their lives to go on day after day, the way they are.

T: I will be so unhappy if I'm just like that.

I'm also like that. My husband always told me, 'I cannot understand, you have taught that grade for so many years and you still sit night after night to make materials. Why?' I was never satisfied with things I have made 5 years ago. And I always got new ideas and new challenges. You want to make new things, because you yourself get bored with the old stuff.

T: Even if your old stuff is good and nice. And that's why I said to FC's pre-primary teacher, I'm getting bored ... because I get out the rest. I wasn't excited when I go to bed, ' Huh tomorrow I'm going to use that new sheet. It's just the old one, works well, nothing wrong with it, put it out. And maybe that is why I'm after a few years now beginning to get 'How can I motivate myself?'

(Discussion on old and outdated worksheets)

T: I wanted to write in my book, and it comes back to what you said about me. Please don't treat me humanistic; tell me what I do wrong straightforward. Don't tell me 'Ja, you are good' so that you feel my self-image will break down. It won't happen. I want to know straightforward, 'in this ... you are totally wrong, you are this and this. I want to know...

That is something that I experienced with both of you. We could be frank with one another. You could be frank with yourself, you could say, 'I didn't do that well today, for this and this and that reason'. I think that is what made this research activity so special. We didn't break down one another. There are 2 ways of doing it. You can be rude towards other people and degrade them, or you can say, 'look at that, that wasn't that good' in a positive way. And I experienced this with both of you, that you didn't feel that I was hurting you as a person, I wasn't hurting your feelings. Our objectives were totally different, and I didn't have to fear that one of you will feel so down and go home and say, 'That Gonnie Kruger! You try your heart out and I don't want to give a lesson again'.

S: We look forward to present ... class again with you, always

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Do you understand the steps in problem solving? When you have your group on the carpet, what are the steps you follow?

S: The paper, thick pencils, hard cover, then the paper they are writing on must be fold in the lines so that they know the first line is for the first problem and the second line for the second problem. They mustn't lie down, they must cross their legs and sit up when they are writing, and if somebody wants, they can use they can use counters that is appropriate for them. It's not a must, if they want.

And now you are asking the problem, what's going to follow?

T: Learners listen and think and then they try to solve it in their books and then reflection.

Now, there's one thing that I haven't seen you doing in your problem solving, and I want you to think about it and start doing it now, because your development goes on. Go back to your syllabus, because one of the components of problem solving is: Learners must identify their own errors and correct them. It means they must understand where they did wrong. Not only, 'look at this one that the child showed on the board and copy it on your paper', 'look and explain what you have done wrong'. So, go to the next step. You didn't come to the last step, but it's as important as all the other steps.

- Getting your materials right
- Children in a circle so that the teacher can see everybody
- Posing your problem
- Learners solve. If they don't understand, they may work together. You must sometimes let learners solve problems in pairs, so that they can talk to one another. It's not always an individual thing.
- Feedback on the chalkboard, all the correct strategies used. If Soria has used this strategy and it was right and Terese used another one, which was also correct, then both of them must demonstrate on the board.

T: Time?

If you do only one, it's fine. Sometimes less is more. If you do one and you do it good, it's better than to do 3 or 4 and they are all half done.

T: At this stage I know that some learners will not realise what their faults was.

You're right, that needs practice, and do that in pairs first.

T: You just go on, they will later...

They will start acquiring the skills. But do that next week. Let them solve their problems in pairs and then you say, 'Pietie and Jannie, what did you do wrong?' and let them discuss what did they do wrong, because they must pay attention to the one who is giving feedback, and there they must realise where they went wrong and correct it by themselves.

How do you understand the term 'learning'? How do you see the process of learning in a child?

S: You can say ... when you start with a new lesson or something new. Let me take for example problem solving ... and I got the group on the carpet and I don't have a clue what is going on, but others do have ... problem solving. And the first time I do it with this group ... and I see ... there is nothing going on ... and as the time is going on I will see they also start drawing the problem ... 'it's easy, I can do it' compared with the previous

You are looking at the evidence, now the child has learned something new, but that process of learning...

T: ... and then they participate and then they solve things with problem solving out, and then they copy in their head. You're learning by heart, seeing this is 3, knowing it afterwards.

Experience it and then you internalise it, make it your own.

T: Ja, but that's not what I want to say. It's like sight words, you see and see and see and after a while

OK, like repetition.

T: Ja! Many of the learning happens when they see it so many times, they experience it, they handle it so many times in different ways and they begin to know.

What role, in learning, do you as a teacher play? What is your role in class to get the children to learn new things?

T: Ek gooi die klip in die bos.

What is the role of any teacher? You have children for a year, and after that year they must know more than in the beginning of the year. What is the role of the teacher, who is she, and how does learning take place through the year, you have both explained a little about it.

T: You're the initiator with an objective in your head and you take them through all the steps to get to that objective.

S: Learners self. They learn from known to unknown something.

What does it mean – from known to unknown? Who is the person that knows?

BOTH: The teacher.

And who is the person who doesn't know?

And what does it mean to lead the child from the known to unknown?

I know that every single teacher in Namibia know about 'from the known to unknown', it's common knowledge, everybody knows it, but what does it really mean? If I were the child today, here, and you had to give me new knowledge, how will you lead me, what is my 'known', and how will you lead me to the unknown?

S: Environment.

That is the...? Ja, you are right!

S: You take him from his environment to the school environment.

T: Or maybe from what he knows now to what he doesn't know. He knows now 1, but you take him to 2.

That's right, that is exactly what I was leading to, because you take him from what he already knows to something new, what is unknown to him.
There is, however, one very, very important thing that you are missing here, and that is: Nobody can learn anything new if you don't understand what it means. I want you to remember that. You can repeat something a 100 times and I can repeat after you, but if I don't understand what I am repeating, I will say it like a parrot, but I will have no understanding of what I'm doing or why I'm doing it. So, learning means understanding. That is the only way that I as a person and every child in your class as a person can come to new knowledge. It is through understanding. And how does that happen? Where does it happen? It happens in the mind; of course we know that, in the mind of the child. And every single child has a different background, a different experience from their environment. All of them come to school with what they have learned, with their skills, some of them can ride a bike, some cannot. Some of them can butter their bread, some cannot. Some of them can tie their shoelaces, some cannot. So, those are skills. They have certain knowledge. Some of them have gardens and they know how plants grow, others have pets and they about caring for animals. So, every child that comes to your class bring different experiences. Some of them buy their bread; others bake their bread. Some of them have seen how a cow is being milked; others have only seen boxes and bottles of milk. They don't have a clue where milk comes from. Maybe somebody could have told them, but they haven't experienced it. So, those are the different experiences in your classroom. And now, what learning entails is: These learners must share their experiences. That is your 'known'. You always begin where the learners are, and those who don't know, they share among one another. You are not the only person who knows in class. That is the bottom line. Children have different experiences, they share, and then the teacher fills in the blanks, because you must lead them to more knowledge and new knowledge. The children only internalise this if they really understand. Take you, if you had been my 2 learners during this research process. I didn't teach you everything. Most of what you're doing you found out for yourself and that is the best way of learning. When learners learn from one another, when they reflect on their own experiences, and you are always there to bring them to a higher level.
Terese, at one stage you suggested something. At that stage I didn't think that you were ready to take that path, but I think you can try it out now. You are a person who likes it to be quiet in class when you do problem solving and you were wondering whether you could do the games activities that are noisy on day and then you reserve a day or two, give the learners individual work, all their worksheets. You then take them group-by-group and do problem solving while the class is quiet. (That means no worksheets on games days). I think you can start experimenting with that now.
T: The other thing I'm thinking of: this number concept development, if I understand the word correctly, I feel that a child will do better in problem solving if he developed a good number concept. So I felt a need to let them do more individual number concept development. It doesn't help me that I don't know how 3 ... but I have to solve a problem with 3. So I was thinking of maybe using this groups, but instead of doing problem solving, I do number concept development in a small group. Because I feel problem solving needs a lot of concentration. You have to be quiet, you have to listen, you have to think. But number concept development are playing. You know, grabbing, whatever, that I can maybe just work out something that in these 3 groups I took them for number concept development so that I can also help them individually and then I do my problem solving also in small groups, but just in another way. I want to try it.
100%! You can do that. I did that, because it's also the only way that you can assess number concept development. If you have a small group and you let them practise these things with counters and then you also ask your number concept questions. Most of these are verbal feedback and not that easy to assess that with pencil and paper.
T: The other thing is with problem solving, they talk so soft when they explain. The others can't hear them.
S: Sometimes they have language problem.
There are 3 things that I want to ask from you. First, when you have done your planning as a grade group, and I know you're not fond of planning...
S: I have started.
Don't remain in the ditch. Don't teach the things that had been taught in 1995 if you don't feel like that. You can still teach the same topics, but bring new suggestions to the group or try out new interesting and challenging ideas in your own classroom. You don't need to be duplicates of one another.
Second, try to concentrate more on peer assessment in small groups.
S: Afterwards, are you going to ask who did know, or what?
You will see where learners assist one another. Also try out assessment in pairs. This is not your recorded assessment, this is where children assess one another and give peer support, because you cannot do everything.
T: Looking at the assessment video, that's what I thought: it helps the children, but it doesn't help me a lot.
Assessment is not only about writing marks down. It's also making sure the children understand what they are doing, know work and can repeat or whatever the purpose for that assessment might be.
Third, I will always be sitting in the corner of your classroom with my camera. I will be there every day, watching you.
S: Mathematics is the most common one in my class.
T: Ja, but it's because you are working on the subject. I said the other day, when I'm on a high with one subject, the others are low. But then you have to take another subject again and work on it until it is part of you.

CONCLUDING STATEMENT OF THE RESEARCH PROCESS

CONCLUDING STATEMENT OF THE RESEARCH PROCESS

BACKGROUND

The very first entry into my study journal was a quote from St Augustine of Hippo that I saw once somewhere on a wall: "Faith is to believe what you cannot see; your reward is to see what you almost cannot believe". At the time my only reward was the fact that I was allowed to the M.Ed (GETP) programme, *ad eundum gradum student,* granted the status of B.Ed (Honours). Since then my reward has become much more meaningful, greater than I could believe!

Getting started on the course reminded me of a novice canoeist on a marathon expedition: getting into the water with only one focus in mind: travelling downstream to reach the finish line. Knowing the distance I was about to travel, but not knowing where the rapids, rocks and whirlpools were, I started paddling. I found myself struggling to keep afloat, following the directions of my supervisors, dodging the rocks, struggling through the rough waters without capsizing. Just to find smooth, still waters around the next bend, allowing me to relax and enjoy the view, realising that all of this is more than worthwhile. Physical strength, endurance, perseverance, keeping an open clear mind, focusing on the situation, were some of the qualities I had to acquire during my journey.
And yet, I have not arrived...

RESEARCH METHODOLOGIES

As a novice in academic writing as well as in research, it required much time and effort from me to come to terms with my research studies. Doing four different short studies instead of a half thesis was just a wonderful experience. It gave me such a rich experience in different research methodologies. Though, I would have liked to attend the *Research Methodology Course,* offered in Grahamstown, very early in my first study year. That would have helped me tremendously, especially with the first two research assignments.

However, I found my own ways of coping. I read a lot about research methodologies and analysis. I frantically took notes during scaffolding sessions so that I could remember all the requirements afterwards. Structuring new research assignments, I looked at others' dissertations, academic writings and journal articles as examples. I did all my referencing immediately during writing, finding the 'blue book', *A Guide to Referencing your Written Work* most useful as a support material.

My involvement in research at NIED, viz. the monitoring of Lower Primary teaching in 2003, the recent *Sexual Health and HIV/AIDS Education* research as well as the annual BETD Inset and ECD moderation activities have also served to broaden my research experience. The research experiences I endeavoured into ranged from surveys and interviews through document analysis and empirical observational action research studies on National level. The most difficult was the philosophical research study and the most rewarding was the action research case study. The literature review opened my mind to a whole new world.

THE PORTFOLIO

The idea of building up a research portfolio appealed to me right from the beginning. I was not sure whether I would be able to keep the pace with the rest of the Masters group, or to be successful in my research attempts. It was good to know that one would have a second chance to fix each assignment and that there would be more assignments to follow, should one of them turn out to be of poorer quality. I thus started off each time with a raw draft, re-working and polishing it up to five times before I could deliver a 'Draft #1' to my supervisors. After the first reading and feedback, it then took a final re-work to get it in final shape. I am glad, though, that I took up the task immediately after each contact session, even under the most hectic circumstances. It meant that I would not be overwhelmed with unfinished business towards the end of the second study year.

Today I feel proud of each and every draft in my portfolio, because I know what it took to get it there. However, re-looking my first research attempts, I know I would have done them quite differently if I had to do them now that I have gained more experience and insight. But then again...knowledge and understanding are so

dynamic - if you don't stop at some point, you would never stop changing your writing.

Searching and re-searching, working and re-working, being critical about others' and my own views became part of my everyday life. Through this process I have discovered so many dimensions of 'the business of education'. I have discovered the 'deeper why' of educational change and reform, becoming realistic about the complexity thereof. I have discovered the 'deeper sense' of where we have come from, the roots of the epistemologies. I have discovered the need to include the best of what we had from both paradigms and to transcend beyond Behaviourism and Constructivism into a new context in education.

PERSONAL GROWTH

I read an enormous amount during the two study years. Some of these papers were really hard to digest and forced me to read certain parts a few times over before I could grasp the essence. A good dictionary became my permanent companion. However easier or more complicated, they lead me to other articles, reading wider to make the necessary links and connections. The key readings provided by my supervisors were carefully selected to give me insight into the hearts of the various educational paradigms. They gave the necessary theoretical foundation, not only for my research assignments, but also for my practice.

Apart from the fact that it helped me to link literature to my research, it empowered me as an educationist, developing my academic communication skills. It helped me to develop a wider vocabulary, enabling me to speak my mind, having my 'own voice' in educational matters. It enabled me to listen better and to think critically, gaining respect from my colleagues during crucial times of curriculum review and considering policy issues.

I did all the editing of my academic writing myself. Reading for meaning, I usually circled the key ideas in each paragraph to make sure they hang together and link up with the rest. But reading for editing developed a totally different skill. It required that I 'switch off' from the meaning and just focus on spelling, grammar, punctuation and

referencing. Being an organised person who files and packs away things in neatly organised stacks, I initially wanted to apply this to my academic writing as well. I could not resist listing ideas using numbers of bullets. I had to learn to discuss my ideas and arguments in paragraph format and to give a 'flow' to my writing. Being very fond of creative writing (literature), I had to be careful not to add 'frills' to my academic writing. The support and guidance of my two supervisors were of tremendous value for me.

STRENGTHS AND WEAKNESSES OF THE PROCESS

For a part-time student, I would say that spreading out the research topics over the two years to run parallel with course-work is better than a half thesis. I don't know how you as supervisors could manage along with your own studies and busy schedule, but if students should stick to deadlines submitting assignments (I sometimes thought that you were too lenient), then this is the ideal.

Assessment and resources are so part of the 'business of education' that I believe they should have a stronger emphasis in the research dimension of the course. They could be linked to the curriculum analysis and then be dealt with as seminar presentations, or they could be research topics on their own to complete a portfolio of *Theory and Practice.*

THE WAY AHEAD

With the end of my M.Ed journey in sight, I don't see it as the end of my academic growth. It was never plain sailing and at times I felt like going under, but I have conquered many obstacles and I survived. Even if I do not continue studying, I have promised myself that I would not stop reading.
My journey would not end here...