Critical Reflective Teaching Practice: Enhancing teachers' consciousness of their teaching

Luwango Luiya, Marc Schafer

Abstract

This paper emphasises the aspects that teachers should critically focus on when reflecting on their teaching practices. The paper emerged from a case study that was conducted in three secondary schools in Rundu- northern Namibia. Critical reflective teaching involves thought and action, and it raises teachers' consciousness pertaining to what they do. Through critical reflective practice, teachers scrutinize their beliefs and knowledge of the subject and their practice, through purposeful thoughtfulness.

The selection of the three participants was based on their rich practical professional knowledge and exemplary teaching practices as evidenced. Interviews focused on 'when, what, how and why these selected teachers reflected critically on their practice. Data collection and analysis were done through an interpretive approach. Interviews and document analyses were the two research tools used for data collection and triangulation. Interpretations of the findings were validated through member checking where participants verified the interpretations made of their interview respectively.

Findings of this study show that critical reflection enabled the participating teachers to analyse and evaluate their teaching in line with the strands of teaching mathematics proficiently.

It is also evident that during reflection, teachers identify their strengths and weaknesses that culminate in better planning as alternative teaching approaches are adopted, eventually meeting the demand of mathematical proficiency. Therefore, the study concludes by encouraging teachers to engage in deliberate thinking of what and how they teach for awareness and action.

Introduction

Research indicates that the professional development chosen to implement the reform ideals is crucial to the success of any reform effort (Clarke, as cited in Hart, 2007). Therefore, the introduction of a learner-centred approach to mathematics teaching implies that emphasis on delivering the curriculum is now on the quality and meaningfulness of learning (Namibia. Ministry of Basic Education, Sport and Culture, 1996). As a result, teacher reflection has a vital role to play in improving learner-centred education in Namibia. This is because reflection is viewed as a genuine way to foster positive change in teachers (Namibia. National Institute for Educational Development, 1999). In this case, change in teachers' beliefs pertaining to teaching is required for the implementation of a revised curriculum. However, research indicates that innovative curricula can be very difficult to implement when teachers' conceptions and practices are deeply tied to traditional mathematics pedagogy (Lloyd, 2007). Thus, professional development centred on new approach to classroom practice-particularly in mathematics teaching, is core to the successful implementation of an innovative curriculum.

Bailey et al as cited in Taghilou (2007:90) emphasised that "reflection is the examination of the underlying assumptions and the understanding of the interaction of dispositions (being), practice (doing), and professional knowledge (knowing)". Teachers ought to understand critical reflective pedagogy as a conscious attempt to think before, during, and after the instruction to enhance the learners' academic achievement. Taghilou (2007:90) defines critical reflective practice as "an attempt to understand the learner, the teacher and the learning/teaching process as a whole; and help the pupils move toward ... perfect ...competency... [and] is a means of professional development that begins in the classroom". Hence, critical reflective teaching is essential to the understanding of what professionals do as they deliberately think of how effective their teaching is while being conscious of what experience has taught them. As critical reflection creates room for self-evaluation, teachers tend to gain confidence to pursue new and creative ideas as they strive to embrace change.

The Ministry of Education and Culture's policy (Toward Education for All, 1993) supports that it is the teachers who structure the learning environment and who can keep learning exciting and satisfying or, alternatively who make schooling a pain to endure. It is therefore essential, that mathematics educators help mathematics teachers develop the expertise and skills that will enable them to stimulate learning. Since teaching has a direct impact on the kind of learning taking place in the classroom, the structuring of a learning environment is crucial to maintaining an exciting and satisfying learning (Namibia. Ministry of Education and Culture, 1993). The aforementioned Education policy further indicates that through reflecting on the technical aspects of teaching, teachers are able to conduct critical observations on their lessons and reflect on them to identify problems

encountered. Therefore, learners' academic performance may be improved as a result of effective instructional strategies. However, it is imperative that all educators operate as critical reflective practitioners since reflection also signifies a recognition that the process of learning to teach continues throughout a teacher's entire career, a recognition that no matter how good a teacher education program is, at best, it can only prepare teachers to begin teaching. When embracing the concept of reflective teaching, there is often a commitment by teachers to internalise the disposition and skills to study their teaching and become better at teaching over time, and a commitment to take responsibility for their own professional development. Therefore, if teachers operate as critical reflective practitioners they will think of what they teach and how they teach; and will strive towards remaining at par with the latest development in mathematics teaching.

Purpose of the study

The purpose of this research study was to investigate critical reflective teaching practice in selected three mathematics teachers to find out how critical reflection shapes their teaching practice. The study was also conducted for a half thesis that was submitted in partial fulfilment of the requirements of the degree Master of Education (Mathematics Education).

With the adoption of the Namibian Education Reform policy (Namibia. Ministry of Education and Culture, 1993), transformation in teaching practices is imperative. Successful implementation of the policy rests upon informed and innovative teaching. In addition, since knowledge is not static rather dynamic, critical reflective practice is vital not only for the realization of the Namibian Education reform ideals but also for teachers to be aware of the latest development in mathematics instructional approaches. Clarke as cited in Hart (2007) points out that the realization of any reform depends on the professional development adopted to attain the reform ideals.

Background and Significance

The Education and Training Sector Improvement Programme (ETSIP) outlines that in spite of the Ministry of Education's attempt to improve the qualification of teachers, the nation still lacks quality teachers for effective teaching (Ministry of Education, 2006). Furthermore, the ETSIP document (Ministry of Education, 2006, p.20) reiterates, "even...formally qualified [teachers] still lack competencies critical to improved learning. Including English... Mathematics and Science". In addition, the Kavango Regional Education Conference paper (2008) (Unknown Author) stressed that teachers and educators lack innovative competency and quality leadership thus hindering performance. Recommendations were made that professional development programmes should put emphasis on the improvement of

professional ethics/traits "such as personal, social, academic, innovative and evaluative competencies" (Namibia. Ministry of Education, 2008, p. 6 & 7).

The rationale to conduct this research on critical reflective practice in mathematics education has also been enforced by a finding of Skovsmose (1994, p.123), who declared that "reflective elements have been put outside the door of the mathematical classroom and forgotten, and mathematics education has concentrated on the development of a mathematical proficiency". This also point to the current situation in Namibia whereby professional development workshops conducted for mathematics teachers mostly focus on content knowledge than on aspects pertaining to critical reflective practice.

Brook Field, in Van Harmelen (2006), emphasises four processes central to developing as a critically reflective practitioner. Firstly, it is through analysing their own views that teachers become conscious of how their beliefs, values, cultural practices and social structures influence and affect their teaching practice. Teachers ought to make their notions of reality, which are taken for granted, explicit. Secondly, teachers need to be aware of their past experience, assumptions and cultural context. Thirdly, teachers ought to challenge the current ways of knowing and act by thinking of alternatives. For example, thinking of innovative ways to facilitate learning with understanding. Lastly, analysing things from different viewpoints is necessary for teachers to assimilate relevant ideas too. Additionally, Kincheloe (1991, p.18) argues that "...in the good work place of the democratic school [,] educational improvement occurs when the practitioner learns to think more precisely and conceptually."

With lack of effective teaching, critical reflective practice may possibly be the key to the development of proficiency in mathematics teaching. Dewey as cited by Arthur et al. (2007) emphasizes that teachers' disposition; in terms of being whole-hearted, responsible and open-minded, underpins critical reflective practice. Attitudes such as whole-heartedness, responsibility and open-mindedness may trigger teachers to reflect on their experiences, own mathematical knowledge and own values/beliefs towards mathematics teaching and learning. This study defines what critical reflective practice is, how to reflect critically and when to reflect on own lesson. This study is informative in the sense that it serves as an eye opener for teachers who could think that critical reflective practice is similar to lesson evaluation, which is not the case. The study also calls for teachers to transform their attitude into being whole-hearted, responsible and open-minded since critical reflective practice is a conscious and deliberate glance into a teacher's own practice.
Despite limited research conducted on critical reflective practice in mathematics in Namibia, our research findings have indicated critical reflective practice to be an effective way to shape practice.

This study outlines the value of critical reflective teaching practice in enhancing on going professional development and quality teaching.

Theory informing the study

This study is primarily grounded in two theories, constructivism and meta-cognition, and on the idea of critical thinking. The constructivist theory is based on the work of a Swiss theorist – Jean Piaget born in 1896, in Neuchatel, Switzerland; and a Russian psychologist Lev Vygotsky born in 1896 in Gomel – Russia; who was not constructivists themselves. Research outlines that Vygotsky's views were deeply influenced by the Marxist ideas which prevailed in the Soviet Union in the 1930s, the time of his main psychological writings (Lee V. & Das Gupta P., 1995). Both Vygotsky and Piaget emphasized that cognitive development can be accelerated if instruction is provided at the right time and in the right way (Zindi, F., Peresuh, M., & Mpofu, E., 1997). Piaget believed that knowledge is acquired as a result of a life-long constructive process in which we try to organize, structure, and restructure our experiences in light of existing schemes of thought, and thereby gradually modify and expand these schemes (Bodner, 1986, P.874). The implication this has for teaching is that it calls for teachers to think and reflect critically on their teaching practice to evaluate their instructional approaches, structuring and restructuring it. In addition to meta-cognition, for individuals to be in control of their thinking process, Parson, et al. (2001) stressed that they need to engage themselves in self-planning (planning and organizing own time, and work), self-monitoring (monitoring own progress as a teacher), self-regulating (adjusting own plan to learners' needs and potential), self- questioning (interrogating own work and thinking process), self-reflecting (analysing own teaching practice), and self-reviewing (re-looking at own teaching and thinking), because this is necessary for critical thinking and learning.

Constructivist theorists also argue that learning is an active process of trying to make sense of new experiences, Kilpatrick *et al.* (1997). This occurs when learners integrate new ideas and information into their existing knowledge structures whereby new knowledge becomes unique to their own thinking resulting in accommodation of new knowledge, Kilpatrick *et al.* (1997). Thus, understanding of mathematical concepts is no longer expected to emerge from a mere transmission of knowledge. Instead, learning is expected to emerge through discourse and opportunities to explain (teach) personal understandings to another person and the opportunity to understand (learn) from other people's points of view, Kilpatrick *et al.* (1997). This guides the teacher when reflecting on own beliefs pertaining to how learning occurs.

With regard to meta-cognition theory and thinking, Kilpatrick *et al.* (1997, p. [2]) emphasized "the theory refers to an ability to think about what we are doing and thinking while we are experiencing it". It also cultivates the ability to reflect on experiences and to learn from

them. This further enables teachers to be conscious of the progress of the lesson, identify the setbacks and plan on how to regulate learners' behaviour while teaching. Literature indicates that meta-cognition was developed by John Flavell of Stanford University, who was influenced by the work of Piaget, especially the notion of intentionality. Flavell (1971) discussed that intentionality presupposes thinking that is deliberate and goal-directed, and involves planning a sequence of actions. Flavell (1971) stresses that meta-cognition is intentional, conscious, foresighted, purposeful, and directed at accomplishing a goal or outcome which also consists of both monitoring and regulation aspects. Meta-cognition includes knowledge of one's own cognitive and affective processes and the ability to consciously and deliberately monitor and regulate those processes (Hacker cited in Flavell, 1979). According to Flavell (1979), meta-cognitive monitoring involves meta-cognitive knowledge, meta-cognitive experiences, tasks and goals, and strategies or actions. Flavell defines meta-cognitive knowledge as knowledge or beliefs about factors that affect cognitive activities. Knowledge factors such as person variables, task variables and strategy variables are the factors that affect cognitive activities as stressed by Flavell (1979). This is the meta-cognitive knowledge teachers should possess for them to operate as critical reflective practitioners. Flavell (1979) further states that an individual's knowledge and beliefs about him/herself as a thinker or learner, and what he or she believes about other people's thinking processes constitutes person variables. Information about a proposed task that is available to a person is part of the task category of meta-cognitive knowledge, which guides an individual in the management of a task, and provides information about the degree of success that he is likely to produce. Flavell (1979) discusses further that the strategy category of meta-cognitive knowledge involves identifying goals and sub-goals and selection of cognitive processes to use in their achievement. Thought pertaining to an individual's own meta-cognitive knowledge, goals or strategies can occur before, during or after a cognitive enterprise and can provide internal feedback about current progress, future expectations of progress or completion, degree of comprehension, connecting new information to old and many other events, Flavell (1979). This points out to the fact that teachers could reflect critically before teaching, while teaching and after teaching. This could be done with focus on lesson objectives, teaching strategies, alternative teaching approaches, relevant examples, explanations and illustrations to enhance understanding, the type of tasks to give the learners and how to assess learning as well.

Higgs (1995) terms the thinking instances (before, during and after the lesson as anticipatory reflection (before), contemporaneous reflection (during) and retrospective reflection (after the lesson). Anticipatory reflection is the first and most common form of reflection and embraces the question 'how might I approach teaching' and offers opportunities to make purposeful pedagogical decisions about a course of action to be embarked upon. Contemporaneous reflection, is reflection that is immediately responsive to the learning environment and may be seen as shifts in pedagogical approaches and behaviours which may be either anticipated or unexpected...therefore, contemporaneous reflection is a most

demanding and highly contextual, which is dependent on action and leads to learning from testing during a teaching episode and requires a personal acceptance of the risks involved. Retrospective reflection is initiated by questioning what happened and why, in the teaching episode and this occurs after the teaching episode. It is initiated in response to the actions embarked upon as a result of testing hypotheses and teaching approaches devised through anticipatory reflection, Higgs (1995). Retrospective reflection is what most teachers refer to as lesson evaluation in their attempt to reflect on the lesson delivered.

Dawson (1998) stresses that adults whose meta-cognitive skills are well developed are better problem-solvers, decision makers and critical thinkers and are more able and motivated to learn, and are more likely to be able to regulate their emotions (even in difficult situations), handle complexity, and cope with conflict. Meta-cognitive skills enable teachers to think of the lesson process, identify problems to solve the ones that need immediate attention, being flexible and acting professionally throughout the lesson.

In addition, it was noted that critical reflective teaching is also underpinned by the critical thinking theory. Critical thinking is rooted in the teaching practice and vision of Socrates, which was developed 2,500 years ago. Literature (Paul, Elder & Bartell: retrieved 7/10/2012) shows that Socrates argued that individuals cannot depend upon those in 'authority' to have sound knowledge and insight. He also demonstrated that persons may have power and high positions and yet be deeply confused and irrational. It is for this reason that Socrates established the importance of asking deep questions that probe profoundly into thinking before accepting ideas as worthy of belief. Paul, Elder & Bartell (retrieved 7/10/2012) further outlined that this ancient Greek tradition created the need for anyone who aspired to understand the deeper realities, to think systematically, to trace implications broadly and deeply. This is because for us to reach beyond the surface, thinking that is comprehensive, well-reasoned and responsive to objections is imperative, (Paul R, Elder L. & Bartell T., 1997). Socrates' argument directly links to the need for teachers to reflect critically on teaching approaches in terms of their relevance to their own classroom situation before adopting any teaching approach read in a book or presented in a workshop or so.

Splitter (1991, P.95) pointed out that:

> Thinkers become critical thinkers when they learn to think in ways that are reflective, rule-governed and directed toward making objective claims (judgements) about the world. Critical thinking is basic to any thinking if that thinking is to make sense. Furthermore, teachers must value all learners and approach them respectfully. Teaching 'in a critical manner' means acknowledging each learner's right to question, challenge, and demand reasons, and so on.

Generally, critical reflective practice also means preparing learners to take charge of their own lives as adults, to be equipped with appropriate skills to make sound and independent judgements, Siegel in Splitter (1991).

Research (Dewey cited in Arthur et al. (2007), supports that for a teacher to reflect on own knowledge, core values/beliefs, own experience, own pedagogy/teaching practice, and own understanding of what critical reflective teaching is; s/he needs to be open-minded, wholehearted and responsible. Elbaz as cited in Liston et al (1996), broke up knowledge into five knowledge bases; Knowledge of self, Knowledge of content, Knowledge of teaching and learning, knowledge of pupils and Knowledge of context within schools and society. The five knowledge bases could help teachers whose understanding of knowledge is confined to content knowledge only. Knowledge of self relates to how well a teacher knows him/herself in terms of own strength and weaknesses. Knowledge of content has to do with how well they understand mathematics. Knowledge of teaching and learning has to do with the teaching skills (didactics) they possess and knowledge about how effective learning prevails. Knowledge of pupils pertains to how well a teacher knows his/her learners not only by name but their potential and social background as well. Knowledge of context within schools and society refers to what the teacher knows about the classroom/ school as a learning environment and what s/he knows about the society that could help him/her to link classroom mathematics to learners' daily life.

Method

The intention to execute this study was to find out how the three selected mathematics teachers use critical reflection in their classroom practice and how it shapes their teaching.

This study is specifically bound by the practice of three mathematics teachers in their classroom situation as they were considered worthy of study. A case study method was found appropriate to answer the research question, "since it is the study of an instance in action" (Adelman et al. cited in Cohen, 2002, p.181). Cohen et al. (2000) outlined that a case study can penetrate situations in ways that are not always susceptible to numerical analysis. Case studies can establish cause and effect indeed one of their strengths is that they observe effects in real contexts, recognizing that context is a powerful determinant of both causes and effects.

Anderson (2000) in his definition promotes the use of a case study indicating that it is a qualitative form of inquiry that relies on multiple sources of information. Its distinctive feature is the case that may be an event or process considered worthy of study.

Since the study pertained to teaching practice, individual teacher's teaching experience was regarded as their real-life experience to generate data from. A case study method

enabled the possibility to focus on a particular case in terms of individual teacher's ideas. Structured interviews conducted individually over approximately an hour, were used to gain insight to the use of critical reflective teaching in their approach to mathematics teaching. In addition, from each case, enlightenment on their understanding of what critical reflective teaching emerged. During interviews the three teachers discussed the extent to which they critically think of what they do, and attempts or actions they take to continually develop professionally. Interview questions were structured with reference to ideas from sources such as Flavell (1979), Liston *et al* (1996), Culver cited in Kilpatrick et al, 1997, Macintyre cited in Harrison et al, 2005 and Higgs (1995).

Sample

Three participants, one female and two male teachers, who are full-time mathematics teachers and are in their mid-thirties to forties participated in the study. The sample includes an ordinary teacher, a mathematics head of department and a school principal, who is also a mathematics teacher. All the participating teachers are non-English speaking Namibians whereby English is spoken as a second language. In addition, they all have more than 4 years of teaching experience.

Considering the nature of the research, the sample necessitated teachers with rich practical professional knowledge, teachers teaching in Secondary School, teachers residing in Rundu and who are reflective practitioners. The secondary school level of teaching was selected because it is the level at which one of the researchers operated as a teacher. Researchers conveniently selected schools that are easy to reach to facilitate the research process. There was a good working relationship with the participants. This is because one of the researchers has worked with these teachers in cluster mathematics workshops held previously in Rundu where two of the three served as facilitators and the other teacher as an attendant. During these workshops insight as to the possibility for these teachers to execute critical reflective teaching in their mathematics teaching practice was gained. This is based on the fact that the ideas they shared with other teachers during the workshop sounded valid and convincing and that they do actually spend time thinking about their teaching.

The third participant was selected from the three pilot interviews that were carried out. The selection was based on valid data he produced during the interview process and positive attitude displayed when approached in relation to the other two participants. Moreover, the selection of these teachers was based on the fact that they are currently mathematics educators and are thus directly involved with learners.

Instrument

With regard to the research process, information was collected through a combination of structured and semi-structured interviews. The interview questions were derived from literature on critical reflective teaching practice that had been analysed. Questions were based on aspects of teaching that a teacher may focus on. Journal articles, books and conference papers were analysed in pursuit of ideas pertaining to professional development through critical reflective practice, in line with the current theory and knowledge. The three teachers' lesson plans were also analysed to gain insight on their way of reflection. This was also a form of triangulation of data since the three teachers' reflections were summarised at the end of the lesson after the delivery of their lessons respectively.

A set of interview questions covering each participant's own knowledge, core values/ beliefs, own experience, own pedagogy/teaching practice, and own understanding of what critical reflective teaching is, were posed. Interviews were semi-structured to probe the teachers' ideas on how they reflect and use critical reflective practice in their classroom situation as indicated below.

Received knowledge/training

The questions below were posed to find out each teacher's kind of teacher training received, reflection on own knowledge and continuous professional development if any.

1. What aspects of your teacher training made you a good teacher?
2. How have your experiences in your teacher training assisted you in planning your lessons?
3. Do you reflect on your own knowledge?
4. Do you attend mathematics content workshops?

Core values/beliefs

Information pertaining to each teacher's belief on how best learners learn mathematics, belief on mathematics as a subject and how it should be taught as well as what they think of, based on mathematics, before teaching.

1. What inspires your work as a mathematics teacher?
2. What is your view on how learners best learn mathematics?
3. How do you ensure mathematical understanding among all learners?

4. Do you think of why you teach the way you teach? Why?
5. What makes you critically think of your teaching?
6. What is your perception on what mathematics education is?
7. How do you reflect on the mathematical knowledge to be taught and the purpose of teaching it?

Experiences as a learner

The impact of their experiences as a learner and how they relate mathematics to daily life was extracted by posing the questions below.

1. Reflect back when you were a learner at school, what childhood experiences have impacted on your teaching now?
2. Do you reflect on how mathematics is used in the community in which you live? How do you use this in your teaching?
3. Who were your role models in your mathematics teaching? Why?
4. What aspects of their teaching affect you today?
5. How do you use your past teaching experience to guide your teaching now?

Teacher practice

The intention here was to gain insight into each teacher's teaching strategies, learning resource materials used, lesson evaluation strategies and to find out where they document their lesson evaluations.

1. What are your strategies to identify learners' difficulties in learning mathematics? (Elaborate).
2. What kind of resources do you use to teach mathematics?
3. What different teaching strategies do you employ in your classroom?
4. How do you evaluate your lessons to find out whether the objectives have been met or not?
5. How do you involve learners in your lesson evaluation?
6. How do you use exam results to evaluate your teaching?
7. Do you write down your thoughts and actions?

Critical reflection in general

This section aimed to find out each teacher's general understanding of what critical reflective teaching practice is.

1. What do you think critical reflective teaching in mathematics education is?
2. What is the importance of reflecting critically?
3. Despite reflecting on the learning that occurs within your classroom, what other lesson aspects do you reflect on that enable or obstruct learning?
4. How do you use critical reflection (thinking critically about your lesson) in your teaching?
5. What else do you do to improve your mathematics teaching practice?

Data collection

The actual interview, conducted individually, comprised of five sets of questions with a specific focus on the five arenas of reflection. I focussed on the teacher's educational background, experiences as a teacher/learner, core values/beliefs, and teaching practice and own knowledge as a teacher. With regard to educational background, discussion centred on the teacher's academic and professional qualification and how this informed their teaching at present. Pilot interview questions were expanded on and changes were made with the assistance of my supervisor.

The data collected consisted of 4 formal interview transcripts. The first was a pilot interview transcript and the remaining three were the transcripts of the actual interviews. The data were collected mainly through interviews and document analysis. The interviews were audio-recorded and my role during the interview was to take short notes, pose questions, clarify questions, listen attentively and probe for further deliberation on particular aspects that I deemed relevant to my research.

Results

The findings of the study show that during the process of reflection, the three teachers think of the mathematical knowledge they received through training, their educational experiences, core values/beliefs and their teaching practice. The interviews show that the three teachers engage in what Hall, cited in Van Harmelen (2006), referred to as 'deliberate and systematic reflection'. The participants also discussed the importance of critical reflection in general. According to them critical reflective teaching transforms classroom practice.

The teachers defined critical reflection as being conscious of learners' progress to evaluate their own teaching practice as teachers. It is also a process of being conscious of what they teach, how they teach and whether they teach as expected. They pointed out that critical reflection enables teachers to find alternative approaches to teaching, which may enhance the learning of mathematics with understanding. They also pointed out that critical reflection also helps to anticipate problems instruction may pose to the learners. Furthermore, they emphasised that critical reflection enables them to decide whether to proceed with a new lesson or not.

Evidence of reflection in the three teachers is demonstrated in their lesson plans where they usually write their lesson reflection and the lesson plans were attached to the thesis as appendices. In the analysis chapter, the extracts from the interviews provide evidence of how the three teachers reflect on their teaching and their views on critical reflective teaching. The theme that emerged is that critical reflection directs planning in terms of future actions to execute.

Details on aspects the three teachers reflect on and the purpose of reflecting before, during and after the lesson are provided below.

Each of the three teachers indicated that they reflect on the following aspects, before the lesson:

- **Content knowledge,** whereby they think of how to link classroom mathematics to real life mathematics;
- **Teaching method** that may facilitate understanding through connecting prior knowledge to new knowledge;
- **Past experience** to emulate good practice from their previous teachers/lecturers;
- **Activities** learners may find interesting and practical. Also for learners to work extensively beginning with easy tasks towards challenging ones;
- **Time,** so that adequate work is prepared;
- **Learners' ability** in terms of finding ways to identify slow learners with the intention to accommodate slow, average and fast learners in their lessons;
- **Role as a teacher** with regard to how to explain mathematical tasks and content knowledge;
- **Conclusion** to find ways to conclude the lesson;
- **Management** to find ways to address new encounters related to teaching and discipline and
- **Resources** that may enhance learning with understanding in an easy manner.

The teachers also indicated that they reflect on the following aspect, during the lesson:

- **Understanding** to observe progress and detect misconceptions. During the lesson, understanding is also checked through posing questions to slow learners.

The aspects that the teachers reflect on after the lesson include:

- **Objectives** and the extent to which the purpose of the lesson has been achieved;
- **Understanding** of mathematical concepts discussed during the lesson;
- **Delivery** of the lesson with focus on the teaching pace and the clarity of instruction given by the teacher;
- **Time management**, with a focus on the use of time during the lesson;
- **Teaching method in order** to find out if it facilitated understanding or not;
- **Scope** in terms of organising extra-classes to cover the large scope of work;
- **Performance in tests/examination** to gain insight on the extent to which learning with understanding has occurred in order to identify problems learners encountered in particular lessons; and
- **Providing feedback** to address misconceptions for learners to rectify their mistakes.

In order to analyse critical reflective teaching of the three teachers, the researchers had to consider what good practice entails in broad terms. I understand the word 'critical' as in-depth reflection. While the literature appears overwhelmingly to show that critical reflection by teachers on their practice improves their performance as teachers, this study did not specifically conduct an independent test of improved performance by these teachers. All the participants spoke about areas where they improved and backed these with examples, and these claims of improvement by these teachers seem very credible. Yet it needs to be noted that this study did not conduct an independent test of these claims, which was beyond the scope of this study. The goals of the study were to investigate three mathematics teachers' critical reflective practice and to find out the effect critical reflection has on their teaching, of which this study has successfully met. Recommendations for further research to examine how these or other teachers follow up and take action on their reflection are suggested below.

Conclusion

An investigation of the selected three teachers' critical reflective practice was conducted in this study. Constructivism, meta-cognition and critical thinking formed the theoretical framework, while Kilpatrick *et al* (1997), Kilpatrick *et al* (2001), Liston et al (1996), Culver

cited in Kilpatrick et al, 1997, Macintyre cited in Harrison et al, (2005), Higgs (1995) and Flavel's (1979) ideas informed the analysis. The result of this study reveals that participants demonstrated a level of reflection in a broad sense. During the interviews the three teachers indicated that they do engage in what Hall cited in Van Harmelen (2006) referred to as 'deliberate and systematic reflection'. The participants indicated to reflect before the lesson (when planning), during the lesson (when teaching) and after the lesson (when teaching is over).

Until teachers analyse their teaching in line with the reform ideals, transformation in education will remain ineffective. This may impede the success of the implementation of the Namibian education reform. Central to this is teachers' beliefs towards the nature of mathematics as a subject and their beliefs pertaining to instructional approaches in mathematics.

Recommendations

Though no generalizations can be made from this study, it casts light on and paves the way for larger-scale research. It may serve as a starting place for further research with the purpose to improve classroom practice. Thus, I recommend that administrators, curriculum planners and policy makers embrace the notion of critical reflective practice and develop in-service programmes for teachers in this area. I think it is inadequate to only outline in printed handouts or brief presentations the importance of critical reflective practices; rather it is necessary to assist teachers to develop as reflective practitioners too. Additionally, a 'Teacher-Self Evaluation Instrument', could be developed particularly to guide mathematics teachers on key aspects to focus on during reflection. In addition, teachers are recommended to take the initiative to develop their own reflective competence to improve their own mathematics teaching proficiency in conjunction with other developmental programmes in education.

This study serves to enlighten teachers on the understanding of what critical reflective teaching entails within the mathematics classroom, but the principles most probably apply to other subject disciplines as well. Therefore pre-service, in-service teachers, teacher educators, policy makers, as well as other administrators in education may find this study helpful in terms of professional development.

References

Anderson, G. (2000). *Fundamentals of educational research.* Falmer Press. 'Lecture handout, partially referenced'.

Arthur, C. S., Miller, R., Thibado, N., Rule, C.A., Dunham, E., & Stoker, J. (2007). Pre-service elementary teachers' reflective insights from teaching mathematics during and authentic early practicum experience. *Journal of Authentic Learning, 4*(1), 43-64.

Bodner, G. M. (1986). *Constructivism: a theory of knowledge. Journal of chemical Education, 63 (10),* 873-878

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education,* (5th ed.). New York: Routledge Falmer.

Dawson, T. (1998). *Metacognition and learning in adulthood.* Developmental testing service, LLC

Flavell (undated). *Theories of learning in Educational psychology.* Retrieved July 9, 2012, from http://www.lifecircles-inc.com/learningtheories/constructivism/flavell.html-originalsource

Gates, P. (Ed.). (2001). *Issues in mathematics teaching.* London: Routledge Falmer.

Harrison, J., Lawson, T., & Wortley, A. (2005). Facilitating the professional learning of new teachers through critical reflection on practice during mentoring meetings. *European Journal of Teacher Education, 28* (3), 267-292.

Hart, L.C. (2007). *Teacher' perceptions and beliefs about factors that influence change in Pedagogy.* Retrieved December 14, 2007, from http://64.233.183.104/search?q=cache:Eb4QgBc7ilYJ:www.uni-duisburg.de/FB11/PR

Higgs, P. (Ed.) (1995). *Metatheories in philosophy of education.* Johannesburg: Heinemann.

Kilpatrick, C., Hart, L., Najee-ullah, D., Mitchem, P. (1997). *Reflective teaching practice by university faculty: Rationale and case study in computer science.* Department of Mathematics and Computer Science, Frontiers in education conference. Atlanta: Georgia State University

Kilpatrick, J., Swafford, J., & Swindell, B. (Eds.). (2001). *Adding it up: Helping children learn mathematics.* Washington: National Academy Press.

Kincheloe, J. L. (1991). *Teachers as researchers: Qualitative inquiry as a path to empowerment.* London: The Falmer Press.

Lee, V., & Das Gupta P. (1995). *Children's cognitive and language development.* United Kingdom: Blakwell Publishers Limited.

Liston, D. P., & Zeicher, M. K., (Eds.). (1996). *Reflective teaching and the social conditions of schooling. A series for perspective and practicing teachers.* ...: Lawrence Erlbaum Associates

Lloyd, M. G. (2007). *Learning with and about mathematics curriculum: the role of teachers' Conceptions.* Retrieved December 14, 2007, from http://64.233.183.104/search?q=cache:Eb4QgBc7ilYJ:www.uni-duisburg.de/FB11/PR

Namibia. Ministry of Education (2006). *Education and Training Sector Improvement Programme* Okahandja: NIED

Namibia. Ministry of Education. (2008). Kavango education region towards quality teaching and learning. *Proceedings of the Kavango Regional Education Conference* (pp. 1-9). Rundu: Kavango Education region

Namibia. Ministry of Education and Culture. (1993). *Toward education for all: A developmental brief for education, culture and training*. Windhoek: Gamsberg Macmillan.

Parsons, R.D., Hinson,S.L. & Sardo-Brown, D. (2001). *Educational Psychology: A practitioner-Researcher model of teaching*. Wadsworth: Thomson learning

Paul, R., Elder L., & Bartel T. (1997). *California teacher preparation for instruction in critical thinking: Research findings and policy recommendations.* State of California: Sacramento

Skovsmose, O. (1994). *Towards a philosophy of critical mathematics education.* Netherlands: Kluwer Academic Publishers.

Splitter, L.J. (1991). Critical thinking: what, why, when and how. *Educational Philosophy and theory 23(1)*, 89-109.

Van Harmelen, U. (2006). *Curriculum course outline.* Unpublished PGCE lecture notes, Rhodes University, Education department, Grahamstown.

Zindi, F., Peresuh M. & Mpofu, E. (1997). *Psychology for the classroom.* Harare: College Press Publishers.