

CHAPTER 2: Literature Review

Literature reviewed here relates to the national innovation to show what it entails and the shift to OBE and Learning Areas in the new curriculum, and in particular to Mathematics as a Learning Area. Next it focused on literature debating the adjudications of worth, evaluation approaches and evaluation literature distinguished from design and development. And finally, research into Mathematics as a Learning Area in C2005 is reviewed to understand the nature of the curriculum studied, and studies in Mathematics and their findings.

National Innovation: OBE and C2005

The new curriculum (C2005) came as the national innovation introduced to move from the apartheid education to a curriculum that will assist in developing thinking and problem solving skills in the interest of all South Africans. C2005 has different approach to education and learning as compared to the previous curriculum. C2005 differs with the previous curriculum in that it allows for learners' meaningful involvement in lesson, critical thinking, reasoning, reflection, integration of knowledge, skills, attitudes and values, learning that is relevant and connected to real life situations, learner-centeredness and open for public comments (Northern Province Department of Education, 2001:4). The previous curriculum was characterized by learning that was exam-driven, rote, content-based, teacher-centered, subject bound knowledge, rigid to time frames and not open to criticism (Northern Province Department of Education, 2001:4). C2005 has outcomes that are focused on enabling learners to achieve the seven critical outcomes designed by South African Qualification Authority (SAQA), which are: 1. Identify and solve problems using critical and creative thinking; 2. Work effectively as a member of a team, group,

organization and community; 3. Organize and manage themselves and their activities responsibly and effectively; 4. Collect, analyze, organize and critically evaluate information; 5. Communicate effectively using visual, mathematical and/or language skills in the modes of oral or written presentation; 6. Use science and technology effectively and critically, showing responsibility towards the environment and the health of others; and 7. Understand that the world is a set of related systems and that problem-solving contexts, therefore, do not exist in isolation (Northern Province Department of Education, 2001:4).

The OBE curriculum is guided by key principles. Central to these key principles is the learner-centered approach to teaching. Learner-centered approach refers to activities and efforts of teaching and learning being geared towards scaffolding and mediating the learner to meaningfully construct own knowledge. Scaffolding refers to providing temporary, adjustable support and a framework for learning while mediation means that something comes in between the learner and his or her learning to assist interpret and understand things they learn about (Brodie, 1997). Mediation factors include learners' existing knowledge or concepts, their language, attitude, values and other people they socialize with. Learners are to learn at their own pace and learning is skill oriented rather than content oriented. Learner-centered approach is often equated with activity-based learning, but activity-based learning need not be learner-centered because it might involve topics that students perceive as totally esoteric (Malcolm, 1996). Some most important aspects to be considered for learner-centered approach are that: the curriculum and teachers should have respect for learners' beliefs, interests and learning strategies; learners should take part in the choice of content, contexts and approaches to learning; authors of the learning support materials should have knowledge of learners they write their materials for and that they should understand learners' thinking, purpose, beliefs, interests so as to have

collective consciousness (Malcolm, 1996). Mediation and scaffolding becomes the new roles that teachers should practice as they use learner-centered approach in C2005 delivery.

OBE and C2005 aim at developing to the fullest the potential of each learner and developing learners who will have what Skemp calls “relational understanding” (Skemp, 1976). Relational understanding is about knowing what to do and why to do it. This resembles a constructivist perspective on learning, which assumes that concepts are not taken directly from experience, but that a person’s ability to learn from and what he learns from experience depend on the quality of the ideas that he is able to bring to that experience (Olivier, 1989). This means that conceptual development does not simply arise from experience, but it arises from the interaction between experience and the existing knowledge structures of the learner. Hatano (1996) indicates that knowledge acquisition is characterized by construction, it involves restructuring, is constrained, is acquired domain by domain, and that it is situated in context. This relate to learners having the ability to interpret, analyze, enrich and connect new knowledge with their existing knowledge so that they construct their own knowledge. According to Olivier (1989), people construct more knowledge than what they are presented with or told.

The above considerations of learner-centered approach in C2005 and OBE present some serious challenges that teachers face in implementing the new curriculum. This is mostly because it requires paradigm shift from the old traditional curriculum practice; where the teacher was the center of knowledge that could be transmitted to learners. In the old traditional curriculum learners were expected to acquire the transmitted knowledge – which was basically rules or facts without reasons. Learning or understanding was when learners possess the transmitted rules or facts and being able to recall them. Learners had to master sufficiently the selected things for their subjects. Rote teaching and learning formed the basis of the ‘old traditional curriculum

(Spady and Schleich, 1999). In Skemp's view this is called "instrumental understanding" (Skemp, 1976). This type of learning relates to behaviorist theory of learning, which assumes that learners learn what they are taught, or at least some subset of what they are taught. Behaviorism assumes that knowledge can be transferred from one person to another (Olivier, 1989). Teachers were the sources of knowledge to learners in the "old traditional curriculum" which is not the case with the new curriculum.

This makes me assume that achieving the outcomes of the new curriculum might not be that easy for teachers as it requires a paradigm shift in curriculum practices. It is also my assumption that practices of the old traditional curriculum might be seen to be persisting during teachings in the new OBE curriculum, which will have an impact in teachers achieving the desired outcomes of this new curriculum (C2005).

Review on Evaluation Literature

Hamilton defines the term curriculum evaluation as referring to "the process or processes used to weigh relative merits of those educational alternatives which, at any given times, are deemed to fall within the domain of curriculum practice" (Hamilton, 1976:4). Worthen and Sanders (1987:24) talks of evaluation as "the determination of a thing's value". The two definitions indicate that curriculum evaluation deals with making judgments in order to give value to a curriculum. Worthen and Sanders (1987:24) define evaluation as "the act of rendering judgment to determine value -worth and merit- without questioning or diminishing the important role it plays in decision-making and political activities". Curriculum evaluation is about the adjudication of the worth. Broadly speaking, adjudication of the worth refers to judgements made by an evaluator about the success or failure of a curriculum (Hamilton, 1976). This might include

adjudications on whether a curriculum is implemented as intended in terms of the principles informing it, or about the relative merit of a curriculum in comparison with another, or to improve a curriculum by checking for the goodness of fit between the statements of content to be learnt and its actual accomplishment (Basson, 1999). Curriculum evaluation informs and provides data for decision-making. Assessment and measurement refers to seeking for evidence to gauge performance in relation to the set goals or outcomes and cannot be equated to evaluation, but they can be useful in collecting data to be used for curriculum evaluation.

Curriculum evaluation can be done through qualitative and quantitative approaches. Quantitatively, evaluation can be done through measurement evaluation. In qualitative approaches, evaluators seek to elicit informants' perception, to broker multiple views where the evaluator's voice is one among many, and to contribute to decision-making in a non-adjudicatory manner (Basson, 1999). Qualitative approaches to curriculum evaluation differ from quantitative evaluation in that they seek in-depth description of the programme using human and cultural evidence, rather than scientific evidence. Qualitative approaches to curriculum evaluation include evaluation as illumination, connoisseurship and criticism, ethnographic evaluation, utilization-focused evaluation and empowerment evaluation. Using qualitative approaches, the study seeks for in-depth description of the curriculum and practices of teachers in classrooms of Mathematics teaching.

For attaining the focus of this research I will use illuminative evaluation. Illuminative evaluation has its focus on the importance of classroom practice and its description in order to evaluate a curriculum (Parlett and Hamilton, 1976). This approach to evaluation takes into account the wider contexts in which educational innovations function. The approach seeks to find out existing relationships between phenomena and why these relationships exist. Illuminative evaluation is

primarily concerned with description and interpretation of contexts of educational innovations. It is informed by two concepts: 'instructional system' and 'learning milieu'. Instructional system refers to the documents that highlight aims and statements that should guide teaching and learning. In this case it refers to C2005 policy documents, textbooks and other related blueprint materials, e.g. learning programmes of teachers, etc. The second concept is the learning milieu, which refers to what teachers and learners actually do in classrooms with the curriculum. The learning milieu plays a vital role in influencing what happens in the classroom. This is so because learning milieu is constituted by various variables that are social, cultural, institutional and psychological. These variables bring diversity and complexity for the learning milieu. Illuminative evaluation seeks to have an in-depth understanding of contexts of teaching and learning so as to better understand the curriculum through description and interpretation. Illuminative evaluation seeks out for discussion 'matches' and 'mismatches' between instructional system and learning milieu through detailed description. This refers to finding out whether what guided curriculum documents matches with what actually happens in classrooms.

An example of illuminative evaluation is the study conducted by Nonyongo (1997) using the concepts of 'matches and mismatches' from Parlett and Hamilton (1976) to describe and adjudicate students' interpretation of the Distance University Students Support Programme (DUSSPRO) as a programme of the South African Committee for the Higher Education Trust (SACHED) offering tutorial support for students registered for degrees at the major distance education institution in South Africa, University of South Africa (UNISA). The 'matches and mismatches' between the ideal; which include the reduction of "transactional distance" between students and their teachers and what actually happens are uncovered at three levels of provision. The three levels are institutional structure (which include course material), dialogue (between students themselves, and students and teachers) and autonomy (which refer to students taking

responsibility for their own learning) (Nonyongo, 1997: 5-17). Adjudication which were made were according to uncovered ‘matches and mismatches’.

Using illuminative evaluation, this study will adjudicate teaching of percentages in OBE Mathematics in Grade 7 by finding matches and mismatches between the intended teaching in the text and the actual teaching in classrooms.

Review of research in Mathematics as Learning Area in C2005

The Learning Area Mathematical Literacy, Mathematics and Mathematical Sciences (MLMMS) as it is called in C2005 define Mathematics as “the construction of knowledge that deals with qualitative and quantitative relationships of space and time. It is a human activity that deals with patterns, problem-solving, logical thinking etc., in an attempt to understand the world and make use of that understanding. This understanding is expressed, developed and contested through language, symbols and social interaction” (Department of Education, 1997: MLMMS2). The Learning Area has 10 Specific Outcomes (SO) that any focus of teaching should strive to develop learners towards its achievement. Each Specific Outcome has Assessment Criteria that indicate evidence of achievement of the learnt knowledge, Range Statement that indicate the scope, depth and parameters of the achievement; and the Performance Indicators that provide details of content and processes that learners should master. The rationale to the curriculum indicate that it has domains of knowledge that provide powerful numeric, spatial, temporal, symbolic, communicative and other conceptual tools, skills, knowledge, attitudes and values to analyze; make and justify critical decisions; and take transformative action (Department of Education, 1997: MLMMS2). Revisions to C2005 were done and the Learning Area is now called Mathematics, no longer Mathematical Literacy, Mathematics and Mathematical Sciences.

Specific outcomes are now called Learning outcomes; and they are reduced from 10 Specific outcomes to 5 Learning Outcomes of the Learning Area Mathematics in the Revised National Curriculum Statement (RNCS).

Review of research studies in Mathematics

Mathematics teaching and learning is widely said to be a complex process, which results in mathematics as a discipline being labeled difficult to comprehend. McNeil said that ‘mathematics’ as it happens in classrooms, is a weird thing, and that what is taught (or, any event, what students learn) is a collection of rituals for manipulating symbols on paper (Davis, 1988). From these statements by McNeil it becomes evident that mathematics teaching and learning should happen in a way that enables learners to develop meaningful mathematical concepts. Skemp (1976) calls it relational understanding. It is my understanding that a teacher’s belief influences his or her teaching. If the teacher believes that mathematics is about computation of numbers, he or she will teach mathematics in a way that will lead to learners developing instrumental understanding. Doing instrumental teaching is attached to reasons of it being easier to understand, getting immediate reward and being more apparent, and because it involves less knowledge, one can often get right answers quickly and reliably by using instrumental thinking rather than relational understanding (Skemp, 1976). Some contributing factors for teachers to teach instrumentally are the backwash effects of examinations and over-burdened syllabi. Instrumental understanding happens mostly as a result of defensive teaching by teachers. Defensive teaching is when teachers define and summarize what they think is worth knowing by learners. This type of teaching focuses on learners being able to regurgitate and use the provided summaries of knowledge, which is rote learning.

Hatano (1996) in his paper of ‘A conception of knowledge acquisition and its implication for mathematics education’ suggested principles for mathematics education, which include posing interesting problems that are placed in familiar contexts for learners, encouraging learners to bring in their prior skills and ideas, using of proper tools by learners, peer interaction and giving learners ample opportunities to reflect after successful performance so that they can acquire mathematics in more or less disembodied forms. Ellerton (1991) adds on by saying that there should be established-mathematics classrooms that consider learning as an interactive as well as constructive activity. According to Ellerton (1991), teachers and learners should learn to distance themselves from on going activities in order to understand alternative interpretations or solutions, and consider the need to work towards consensus in which various mathematics ideas are co-ordinated is recognized. This means that teachers and learners should not do activities after activities, but should have time to reflect on their understandings of the learnt concepts. According to these suggestions, learner-centered approach can be viewed as proper for enabling learners to develop meaningful mathematics concepts.

Conclusion

In conclusion, the curriculum that is being evaluated is outcomes and skills based. That is, all teaching and learning done guided by the curriculum are to achieve the specific outcomes and desired skills. Illuminative evaluation will be used to get beyond evaluating testing for content only, and to gauge if teaching of percentages in Algebra in the Learning Area of Mathematics is taught as intended in C2005. Illuminative evaluation literature also links to doing classroom-based study in order to adjudicate if the Mathematics Learning Area is taught as intended as opposed to conceptualizing it and other studies of the mathematical gains in student learning.