

CHAPTER 7: Research Findings

Data analysis was done in the previous two chapters; this chapter discusses the findings, recommendations and conclusions drawing from the outcomes of data analysis. Discussions here aimed at fulfilling the focus of the study, which is using illuminative evaluation to adjudicate whether the OBE Mathematics Learning Area curriculum is working as intended or not, by seeking for matches between the “intended” and “what actually happened” in Grade 7 Mathematics classes with regard to teaching percentages. The study has two research questions. Data showed that lessons of teaching percentages should have three parts, which are: discussion, algorithm and exercises in responding to Research Question 1 of “How should the concept of percentages in Grade 7 Algebra, as discipline of Mathematics Learning Area, be taught in classrooms?” It further indicated that principles such as Integration, Learner-centeredness, Relevance, Participation and Ownership, Group-work and others are to be considered during the teaching of percentages in OBE Mathematics. Responding to Research Question 2 of “How do teachers actually teach ‘percentages’ in Grade 7 Algebra, to establish if it is taught to outcomes as intended?”, data indicated that about 58% of what actually happened in classrooms showed teachers teaching to the outcomes as planned following for six emergent parts and in about 42% what actually happened did not show enough emergent parts for teachers to be considered as teaching to outcomes as planned. More specifically data indicated three patterns in which teaching happened as planned in the text and two further patterns where teachings sowed too few emergent parts for it to considered happening as planned. Discussions in this chapter compare the ‘instructional system’ with the ‘learning milieu’ in order to find for matches and mismatches between the two to be used for seeing if teaching in classrooms matched what was planned in the OBE Mathematics curriculum.

Matches and Mismatches

How lessons were planned to be taught was matched against how they were actually taught in the learning milieu. Firstly, matches are discussed on the level of principles guiding implementation of OBE and C2005, as in the instructional system. Secondly, matches are discussed following the details of teaching percentages as it happened in the learning milieu.

Planned Policy: Principles of OBE teaching.

Generally speaking, this data indicate that teachers seem to be teaching OBE Mathematics following principles as intended in the curriculum documents.

1. Knowledge Integration

Knowledge integration refers to that knowledge learnt in one Learning Area is applicable or can be used in other Learning Areas. C2005 is a national education framework for South African schools and it is characterized by integrating education and training. It requires an integration of knowledge, skills, attitudes and values. Learning Areas are an integration of various subjects. “On Track with Maths” by Barry and Dugmore (1998) also has an illustrative table on page 20 of the teaching and Assessment Guide, which shows how it integrates with other learning areas. Teachers integrated mathematical knowledge with knowledge of other Learning Areas such as EMS, LO, AC and NS. In many lessons teachers have integrated mathematical knowledge with EMS as they taught learners to calculate percentage loss and profit where they used concepts of Entrepreneurship, such like it happened during the guiding example in the lesson taught by Nhlengano as described in page 49 of this study. In few lessons mathematical knowledge was

integrated with LO when asking learners to calculate percentage of people infected with HIV in their communities and the entire country. A match between the principle of integration and the actual teaching of lessons happened.

2. Learner-centeredness

Learner-centeredness is an approach that put emphasis on what the learner wants and should be able to achieve, to know, to understand, to do and to become. Documents indicated it encourages the use of learner-centered approach to teaching. All teachers involved learners in discussions during their actual teaching of Percentages. This happened when learners do group-work, or when they report back to class their findings, or when they assessed reports with the teacher, and or during the Guiding Examples and once in the Conceptual Introduction. Evidence is seen as an emergent part of report back is found in all 31 lessons observed. An example of learner-centeredness can be seen on page 46 in the emergent part of teacher-learner assessment in the description of the lesson taught by Nhlangano. Matches regarding the principle of learner-centeredness in the documents and in the actual teaching of percentages exist.

3. Relevance

Relevance relate to teachers being able to use situations that are familiar or known to learners during their teachings. This means teachers should take into considerations the context of learning, content to be learnt, knowledge to be acquired through their teaching and the kind of learners they teach. Documents indicate that teachers should try to find relevant situations where percentages can help to make useful comparisons. It calls on teachers to be innovative when designing their learning programmes. This requires teachers to contextualize knowledge they

teach to situations known to learners. Most teachers used the idea of selling sweets at a profitable price, buying clothes at discounted prices and saving money from which learners are given as pocket money to use at school. These situations are familiar to learners, in-fact they are being practiced on day-to-day living. Relevancy in teaching percentages also assists teachers in achieving AC6 of SO1 of solving real life and simulated problems. Here what is expected in documents regarding relevance and what actually happened when teachers taught percentages show matches. Evidence can be seen in the description of what actually happen in lesson in page 54, in the emergent part of teacher-learners assessment.

4. Participation and Ownership

Participation and Ownership refers to learners being able to actively involve themselves in the teaching and learning process and construct knowledge that becomes owned as theirs. Documents indicate that learners need to actively participate and to own the learning process, since it be called learner-centered approach to teaching. Text also encourage the use of cooperative learning, where learners should be given opportunity to react to ideas, experience and generate alternative ways of thinking and feeling. This mostly happens when learners interact with one another. During the teaching of percentages learners were seated in groups working together doing discussion and reporting to the whole class their findings. Although in about 42% of the lessons teachers' teachings were not as planned in C2005 and OBE, the fact that learners were able to discuss problems and report back their findings during these lessons shows some participation and ownership to the learning process. Data show that in all observed lessons the emergent part of report back actually happened. A match exists between the intended in documents and the actual learning during teaching of Percentages.

5. Conceptual development

The 'instructional system' states that learners should develop mathematical thinking, knowledge, social skills and personal attributes. SO6 state that learners should be able to use data from various contexts to make informed judgements. This could be achieved when learners are afforded to develop meaningful mathematical concepts, facilitated by discussion of mathematical concepts. Data from observation shows that only one lesson had a conceptual introduction discussed, which shows that learners were not afforded opportunities of constructing meaningful understanding of mathematical concepts. This shows a mismatch between the actual teaching in the learning milieu and the instructional system as intended in the documents.

6. Group-work

The 'instructional system' advocates the use of group-work as a strategy in learner-centeredness. Group-work is when learners are clustered together in groups to learn cooperatively. Cooperative learning affords learners an opportunity to react on ideas, experience, insight and knowledge of generating alternative ways of thinking and feeling (Northern Province Department of Education, 2001:18). In all classes of OBE Mathematics teaching as observed, learners were arranged to sit in groups. This then indicates the existence of matches between the 'instructional system' and the 'learning milieu' regarding the principle of group-work.

Generally speaking, thus evidence suggests that teachers seem to be teaching OBE Mathematics following principles as intended in the documents. Five out of six principles above indicate teachers' teaching in the learning milieu including the principles in their teachings to be matching how the instructional system intends teaching to be done. That is, teachers indicated to integrate

mathematical knowledge with knowledge of other learning areas. Learner-centeredness was achieved when teachers discussed and reported their findings. Relevancy was achieved by using situations known to learners and that learners participated and owned learning as they reported their findings and assessing reports from other learners. Group-work was achieved since all learners were arranged to sit in groups and also given work to discuss within their groups. These matches constitute about 83.3% of teachers teaching OBE lessons utilizing principles fundamental or key to C2005. The learning milieu matches the instructional system in terms of the planned policy regarding teaching of Percentages in OBE Mathematics.

Instructional System and Learning Milieu

Corroborating this, the observation data indicates teachers are teaching to OBE Mathematics as intended in the 'instructional system'. About 58% of teachers seem to be teaching as in the text and about 42% are not. The 'instructional system' indicates that teaching percentages should be in three elements; that is: discussion, algorithm and exercises. Patterns of how percentages were taught in the 'learning milieu' consist of six emergent parts: Conceptual Introduction, Guiding Example, Group-work, Report-back, Teacher-Learners' assessment and the Concluding Exercise. Table 4 below shows the matches between 'instructional system' and patterns in the 'learning milieu'.

Table 4: Instructional System and pattern of the Learning Milieu

Instructional System	Pattern in the learning milieu
1. Discussion	1. Conceptual introduction
2. Algorithm	2. Guiding example 3. Group work 4. Report Back 5. Teacher and Learners' assessment
3. Exercises	6. Concluding Homework / Class-work

Discussion in the 'instructional system' matches Conceptual Introduction in the 'learning milieu' in that the concept of percentage is to be discussed for learners to develop an understanding of percentages. Algorithm in the 'instructional system' matches to four parts in the 'learning milieu', Guiding example, Group-work, Report back and Assessment by both the teacher and learners. This is so because as the teacher gives guiding examples to the whole class, learners are then given work in groups to reinforce the newly learnt concept, which they report back when finished and the whole class together with the teacher assesses if learners did work correctly. Exercise in the 'instructional system' matches to the Concluding Exercise which is either homework or a class-work in the 'learning milieu'. Matches and mismatches between the 'instructional system' and the 'learning milieu' were found following the patterns of teaching formed by emergent parts of individual lessons. Discursions of matches were as follows:

1. Pattern One: Match.

Strong matches were seen in Pattern 1 between the 'learning milieu' regarding teaching percentages with the text. The pattern consists of all six parts of the lesson for teaching OBE

Mathematics, which matches more closely with the three parts of the ‘instructional system’ as indicated in Table 4. The Discussion in the ‘instructional system’ matches with Conceptual Introduction in the ‘learning milieu’ in that the teacher had introduced the concept of percentages to learners and discussed its meaning. The algorithm in the ‘instructional system’ matches with the guiding example in the pattern of the ‘learning milieu’ as the teacher gave two guiding examples to learners during his teaching. The algorithm also matches with group-work, report back and teacher-learners’ assessment as learners were given work to do in groups after which they gave reports which were assessed by both the teacher and learners in the ‘learning milieu’. Exercise in the ‘instructional system’ matches with the concluding exercise given to learners from the text.

There is only one lesson taught in this pattern. This lesson shows most persuasively that the teaching of percentages is done as intended in the text. But being only one the lesson does not show strong support of teachers teaching percentages in OBE Mathematics as in the text. Pattern 1 suggests in percentages that about 3.2% of teachers teach OBE Mathematics as planned in the text. However Pattern 2 and Pattern 3 support the findings where eleven and six lessons were taught as to the text, and contributing to the total of 58%.

2. Pattern Two: Match.

Pattern 2 supports teachers teaching OBE Mathematics as planned in the text. Matches are seen less closely in Pattern 2 than in Pattern 1. The pattern had five of six parts of the lesson, which according to Table 4 matches with two parts in the ‘instructional system’. Only one part of conceptual introduction, which matches with discussion in the text, is missing in all lessons of Pattern 2. Parts matching in the pattern include the algorithm in the ‘instructional system’ which

matches with guiding examples teachers used in lessons of this pattern. It further matches with group-work, report back and teacher-learners' assessment because in all eleven lessons of this pattern learners had problems to solve in groups, reported their discussions and both the teacher and learners assessed the reports. Matches also existed in exercises where learners were given exercises from the text. Lessons in Pattern 2 had two variations on how they were taught. The variations were formed by how parts of lessons emerged as lessons were taught. The five parts of lessons that constitutes the variations are the guiding example, group-work, report back, teacher-learners' assessment and the concluding exercise. The first variation was found in of the one lesson that started by learners giving the report back of the homework, followed by teacher-learners' assessment, then exercise, followed by guiding example and discussions in group-work. The second variation is of the ten lessons where teaching started with guiding examples, followed by group-work, then report back followed by teacher-learners' assessment and was concluded with exercises. Matches between the 'instructional system' and the 'learning milieu' exist throughout lessons of Pattern 2, including within all the variations of lessons.

Pattern 2 showed matches, but not as strong as complete as in Pattern 1. These lessons provide support to a lesson in Pattern 1 about teachers teaching percentages as it is in the text. This data strengthens the case of teachers teaching to OBE Mathematics constituting about 35.4% of teachers, which when corroborated with Pattern 1 makes about 38.6% of teachers teaching to OBE Mathematics as intended in the curriculum.

3. Pattern Three: Match.

Pattern 3 also provided support for teachers teaching to OBE Mathematics. Matches between the 'instructional system' and the 'learning milieu' are apparent in Pattern 3. This pattern has six

lessons that were taught to the text, with four parts of the lesson in the 'learning milieu' matching the 'instructional system'. Parts missing in Pattern 3 are conceptual introduction and guiding example in five lessons; and conceptual introduction and concluding exercise in the sixth lesson. Pattern 3 had two variations on how lessons were taught. Four parts of lesson in the first variation are the group-work, report back, teacher-learners' assessment which matches with algorithm in the text and concluding exercise which matches with exercise in the text. In the second variation, algorithm in the text matches with guiding example, group-work, report back and teacher-learners' assessment. The two variations of Pattern 3 showed that matches between the text and the 'learning milieu' confirm that teaching in classrooms following text happen.

Pattern 3 had six lessons in which teachers taught percentages in OBE Mathematics as planned in the text. Pattern 3 showed matches between the 'instructional system' and the 'learning milieu' to exist. Matches between the 'instructional system' and the 'learning milieu' in Pattern 3 lend support to lessons in Patterns 1 and 2 where teachers taught percentages more closely as intended in the text. This then also adds to making the case of teachers teaching percentages in OBE Mathematics as planned in the text more strong. Pattern 3 forms 19.4% of those teachers, which increase the number of teachers teaching percentages in OBE Mathematics to 58%. This evidence of data indicates that just over half of teachers teach percentages in OBE Mathematics as intended in the text of C2005.

4. Pattern Four: Mismatch.

Mismatches were seen in Pattern 4 between the 'instructional system' and the 'learning milieu' on teaching of percentages in OBE Mathematics following the text. Pattern 4 had five lessons which only had three parts of an OBE lesson design. The parts of a lesson in Pattern 4 include

report back, teacher-learners' assessment, and the concluding exercise. Those parts of a lesson fall short to be considered as showing teachers to be teaching percentages in OBE Mathematics as intended in C2005 and the text as 'instructional system'. Pattern 4 formed 16.1% of teachers who could not match teaching percentages as intended in the text. Parts missing in Pattern 4 include the conceptual introduction, which forms the basis of learners developing understanding of mathematical concepts as it involves discussion, guiding example which assist learners to learn how to utilize the learnt mathematical concept, and group-work which enables learners to reinforce the learnt concept as they interact with other learners. Pattern 4 showed only learners doing algorithm of the given exercises and assessment of whether it is done correctly. For the above evidence, lessons in this pattern were considered to show a mismatch between what was planned and what 'actually happened' for the shift to OBE.

5. Pattern Five: Mismatch.

A strong mismatch is seen in Pattern 5 between the 'instructional system' and the 'learning milieu' in teaching of percentages in OBE Mathematics following the text. Pattern 5 had eight lessons where teaching had only two parts of the OBE lesson design. Parts of lessons in Pattern 5 were the report back and the teacher-learners' assessment. Parts missing in Pattern 5 include conceptual introduction, guiding example, group-work and concluding exercises. These missing parts were vital in affording learners opportunities of interacting; thereby cooperatively construct knowledge and meaningful conceptual development. Pattern 5 showed too few signs for teachers to be considered teaching percentages in OBE Mathematics as planned in the text. All lessons in this Pattern showed learners doing calculations of given exercises individually, though seated in groups, and the teacher doing corrections of the work of learners on the chalkboard. Lessons in

Pattern 5 form 25.8% of lessons and strengthen the case of teachers teaching percentages as planned in the text.

Corroborating Pattern 4, Pattern 5 shows further mismatches between the ‘instructional system’ and the ‘learning milieu’ regarding teaching of percentages in OBE Mathematics. Pattern 4 constitutes 16.1% while Pattern 5 constitutes 25.8% which together totals to 42% of teachers who mismatched teaching percentages in OBE Mathematics as intended in the text. This suggests that just below half of teachers have yet to shift to teaching percentages in OBE Mathematics as intended in the text. More than 5 years into the national innovations I was surprised to explore that just below half of teachers mismatched teaching OBE lessons as planned in the text.

Recommendations

The study recommends that OBE teachers need to teach conceptual understanding of mathematics. Teaching conceptual understanding of mathematics requires teachers to first introduce the concept of percentages to learners. Introducing the concept of percentages requires teachers to afford learners an opportunity to discuss, discover and learn the concept by themselves rather than being told. Conceptual introduction allow learners to discover and construct knowledge on their own. Teachers need to assist learners in validating knowledge they construct. This is confirmed by Ellerton (1991) who said “there should be established mathematics classrooms that consider learning as an interactive as well as constructive activity, and that teachers and learners should learn to distance themselves from ongoing activities in order to understand alternative interpretations or solutions, and consider the need to work towards consensus in which various mathematics ideas are coordinated is recognized”. Teachers are to teach conceptual introduction as it forms basis for learners developing understanding of OBE

Mathematics. Intensifying conceptual introduction, teachers need to use guiding examples that would reinforce understanding the concept of percentages. Teachers also need to engage learners in group-work so that they can interactively discuss and assist each other regarding tasks or learning activities they do, where after they report back their findings to the class. The teachers together with learners need to assess the reports given to class by various groups. Teachers need to conclude their lessons by giving learners exercises to do individually either as classwork or homework.

The study further recommends that teachers need to improve their teaching of OBE Mathematics to be teaching toward conceptual understanding of percentages. Improving teaching will happen in different ways for teachers in Patterns 1 to 5, as their teaching did not happen the same way.

For the teacher in Pattern 1, it is recommended that his teaching which included conceptual understanding of mathematics be maintained. The teacher need to maintain his teaching which started by ‘conceptual introduction’ wherein he explained the concept of percentage to learners, and followed by ‘guiding example’, ‘group-work’, and ‘report back’, teacher and learner assessment’ and ‘concluding exercises’, the six emergent parts in teaching these lessons. The teacher need always to have it in his mind that OBE teaching emphasizes achieving outcomes that focus on enabling learners to develop critical thinking powers and problem solving abilities. Critical thinking powers and problem solving abilities are achievable when learners have developed understanding of mathematical concepts they have learned. For continuity in achieving the outcomes of OBE Mathematics teaching, the teacher in Pattern 1 needs not to regress in his teaching methodologies but to maintain progress or improve.

For teachers in Pattern 2 where they omitted ‘conceptual introduction’ in favour of ‘guiding example’, ‘group-work’ and ‘report back’, ‘teacher and learners assessment’ and ‘concluding exercises’, it is recommended that they teach percentages in OBE Mathematics conceptually by way of introduction to lessons. Conceptual introduction plays vital role in assisting learners to develop meaningful understanding of percentages. Conceptual introduction can then be followed by the other five parts of lessons as seen in their teaching. That is, teachers providing ‘guiding examples’, ‘group-work’, ‘report back’, ‘teacher-learner assessment’ and ‘concluding exercises’.

For teachers in Pattern 3 wherein two variations of parts missing in their teaching exit, recommendations to teaching of percentages in OBE Mathematics towards attainment of outcomes are done following the variations. In the first variation wherein teaching omits ‘conceptual introduction’ and ‘guiding example’, it is recommended that teachers need to do conceptual explanation by way of introduction to their lessons and reinforce conceptual understanding by providing guiding examples to learners. In the second variation where teaching omits ‘conceptual introduction’ and ‘concluding exercises’, it is recommended that teachers need to introduce their lessons by doing conceptual explanations and conclude by giving learners exercises. These recommendations are additions to teaching as actually happened in Pattern 3 so that teachers can improve and not regress in teaching OBE Mathematics towards attainment of outcomes.

For teachers in Pattern 4 where teaching omitted ‘conceptual introduction’, ‘guiding example’ and ‘group-work’, it is recommended that they start their teaching by doing ‘conceptual introduction’ wherein they explain concepts to learners by way of introduction to lessons. Teachers also need to reinforce conceptual understanding by providing ‘guiding example’ and

‘group-work’ to learners prior to them doing ‘report back’, ‘teacher and learner assessment’ and ‘concluding exercises’ as it happened in teaching of Pattern 4.

For teachers in Pattern 5 whom their teaching only included ‘report back’ and ‘teacher and learner assessment’, it is recommended that they consider teaching conceptual understanding of percentages in OBE Mathematics by starting lessons with conceptual introduction wherein explanation of concepts is done to learners prior to completing examples and giving exercises to learners. Learners need not learn the algorithm of doing calculations, but need to develop an understanding of why calculations are done the way they are done. In Skemp’s (1976) view knowing what to do and why do it is called “relational understanding” while knowing rules or facts without reasons is called “instrumental understanding”. Teaching of OBE Mathematics need to be geared towards assisting learners to develop relational understanding rather than instrumental understanding so as to achieve the critical outcomes of OBE which aims at enabling learners to work effectively as members of a team, group, organization and community (Northern Province Department of Education, 2001:7). Teachers need to always have it in their minds that OBE teaching aims at attainment of the preset outcomes in the curriculum.

Conclusion

In conclusion, responding to the research question to establish if teaching OBE Mathematics has shifted to outcomes, the study finds disappointingly that only slightly more than 50% of teachers seem to have shifted to OBE, and slightly half the sample seem not to have done so. In addition the study has demonstrated, with one exception, that teachers do not teach the concept first, preferring to work with demonstrated examples through exercises in contrast with what was planned in the OBE text. The main recommendation, thus, is that teachers teach OBE

Mathematics conceptually first as planned: to promote conceptual grasp of Mathematics; assist teachers shift towards outcomes in their teaching; develop OBE teaching strategies in Mathematics; with the view to improving learner grasp of Mathematics and their performance in examinations.