The Role of Data Handling in Teaching and Learning of Mathematics in Grade7 Classes: South African Experience

Prof Emmanuel O. Adu PhD

Faculty of Education, University of Fort Hare, South Africa
eadu@uffh.ac.za

Mr Lizo J. Gasa

Faculty of Education, University of Fort Hare, South Africa
lizogosa@yahoo.com

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Abstract

Mathematics as a subject is an important subject that leads to the development of other scientific fields; in South Africa, the teaching of mathematics seems to experience major problems confronting educators, which are the lack of qualified teachers in the teaching of mathematics, particularly in data handling mostly in rural schools. The other factor is that the majority of learners studying through the medium of English are usually second or third language speakers. It has been noticeable that the education crisis has continued in post-apartheid South Africa. This study investigates the role of data handling in teaching and learning of mathematics among grade 7 students. A qualitative research approach was adopted with semi structure interview as the major instrument to elicit information from the respondents. In addition, document analysis was also used get information concerning the teacher and learners' performance. One hundred and twenty-five participants (125) were chosen using simple random sampling techniques. The information gathered were coded, transcribed, and categorised according to the different themes. The findings revealed among others that, only 11% of the respondents specialised in mathematics; 78% said that their schools did not have enough teachers and learners support materials. Less than 60% of the respondents involved their learners during the teaching and learning and only 11% said that their students always do their homework. It was recommended among others that greater attention should be paid to the needs of larger number of students who currently learn very little useful mathematics; Major innovation is needed to develop a provision that meets the diverse needs of all our students and not just the most talented

Keywords: Teaching and learning, Data handling, Mathematics, Post-apartheid, Education crisis.

1. Introduction

Education in South Africa during the apartheid era (before 1995), was differentiated with the existence of racially separate education departments. The Bantu Education Act (Act No. 47 of 1953) intended to separate black South Africans from the main, comparatively very well resourced education system for whites. The quality of education offered to the black learners was according to Paparistodemu and Meletious-Mavrotheris (2008) of an inferior quality and lacked effectiveness, and black schools had inferior facilities, teachers and textbooks

The policy of education prior 1994 involved segregation of races and a large degree of bureaucracy. This was reflected mostly through the education system. It consisted of four education systems, based on the racial classification of apartheid, each having their own schools and colleges. This system ensured that schooling was racially separated and reflected the apartheid beliefs about race (Paparistodemu and Meletious-Mavrotheris 2008)

Despite the setbacks cited above South Africa has achieved access for all to education. This fact can be substantiated in the GET band (General Education and Training band) phase (Grade R to 9), where the gross enrolment ratio (GER) is 93% (DoE, 2007 cited in Kazima, 2008). Even ethnic minorities have access to a complete, free and compulsory primary education. Primary education spans Grades 1 to seven. The appropriate age for primary schooling in South Africa is 7-13year olds.

Statistics calls for problem solving skills where there are multiple possible solutions, whilst problem solving in the mathematics classroom was characterized by one single correct answer (Gattuso, 2006). Mathematics teachers did not receive adequate training to cope with this very different mind-set, with the result that statistics is often taught by

emphasizing algorithms and formulas, with very few real applications (Gattuso, 2006). Educators in most countries of the world face a number of educational challenges. This is evident in the teaching of statistics in the world in general and Africa in particular. Research in schools has provided elements of practice that work and those that do not work. For example "Constructivism leads to new beliefs about teaching and, learning and about roles of both teachers and students in the process" (Stein et al., 1994, p.26). Students learn mathematics with meaning, when they are active, their existing knowledge, through motivation and relate it to existing educational experience to develop new concepts as new knowledge is constructed. Active participation is therefore imperative for learning.

1.1 Analysis of learner performance and the purpose of data handling in the curriculum

The rationale for this study emanated from the analysis of learner performance in the common tasks for assessment (CTA) which has been a feature in the senior phase. The grade 7 class in most instances resides with primary schools although it is a senior phase class; In this regards the analyses were made by the grade 7 mathematics teachers in a certain circuit in King William's Town District. The analyses revealed that learners generally performed poorly in mathematics. Question by question analyses of the recent CTA showed that the learners performed poorly in the data-handling section of the paper. As per South African curriculum, statistics is defined as data-handling (Doe, 2009). It involves collecting, sorting, and displaying of data in diagrams or charts. (Department for Education and skills 2003). The purpose for the study was to observe the factors that affect the teaching, and learning of Data handling in Grade 7 Maths classes as this area seemed to cause poor performance in mathematics. The researcher also hoped to prove that poor performance in mathematics is not confined to high school.

In CAPS, the purpose of data-handling is to enable the learners to develop skills to collect, organize, display, analyse, and interpret numeric data. In the senior phase the general concepts of data handling involve asking questions and finding answers in order to describe events and the social, technological and economic environment. This knowledge of data handling helps people to make decisions about uncertain situations. It also involves the study of chance or probability (which describes events that do not occur with certainty). It is also used by a variety of occupations for example health professionals' use statistical methods to determine whether a specific drug or procedure is useful in the treatment of a medical problem. Weather forecasters use statistics more accurately to predict weather. Engineers use statistics to benchmark the standards for the product safety and quality (Department of Education, 2010). In Senior phase learners are expected to deal with data in significant social, economic, and environmental contexts, exploring issues such as HIV/AIDS, crime, abuse, and environmental factors.

Through the study of data handling, the learner develops the skills to collect, organize, represent, Interpret, analyse and report data, by:

- Posing of questions for investigation
- Collecting, summarizing, representing and critically analysing data in order to interpret report and make predictions about situations
- Probability of outcomes includes both single and compound events and their relative frequency in simple experiments. While these are the specific aims of teaching data handling in senior phase. The study of probability enables the learner to develop skills and techniques for making informed predictions, and describing randomness and uncertainty. Progression in Data Handling is achieved primarily by:
 - increasing complexity of data sets and contexts reading, interpreting and drawing new types of data graphs, becoming more efficient at organizing and summarizing data
 - becoming more critical and aware of bias and manipulation in representing, analysing and reporting data
 - Learners should work through at least one data cycle for the year – this involves collecting and organizing, representing, analysing, summarizing, interpreting and reporting data. The data cycle provides the opportunity for doing projects.
 - All of the above aspects of data handling should also be dealt with as discrete activities in order to consolidate concepts and to practise skills. For example, learners need to practise summarizing data presented in different forms and summaries should be used when reporting data.
 - Data handling contexts should be selected to build awareness of social, economic and environmental issues.
 - Learners should be sensitized to bias in the collection of data, as well as misrepresentation of data using different scales and different measures of central tendency (mean, mode, median). Collect, organize and summarize data.
 - Pose questions relating to social, economic, and environmental issues in own environment

- Select appropriate sources for the collection of data (including peers, family, newspapers, books and magazines)
- Distinguish between samples and populations and suggest appropriate samples for investigation
- Design and use simple questionnaires to answer questions:- With yes/no type (binary) responses and the use of multiple choice responses to Organize and summarize data
- Organize (including grouping where appropriate) and record data using tally mark- tables stem-and-leaf displays
- Group data into intervals
- Summarize and distinguishing between ungrouped numerical data by determining: - mean, median, mode
- Identify the smallest and largest scores in a data set and determine the difference between them in order to determine the spread of the data (range). Represent data to draw a variety of graphs by hand/technology to display and interpret data (grouped and ungrouped) including bar graphs and double bar graphs, histograms with given intervals, pie charts.
- Critically read and interpret data represented in: words bar graphs, double bar graphs, pie charts histograms
- Critically analyse data by answering questions related to: data categories, including data intervals, data sources and contexts central tendencies (mean, mode, median) scales used on graphs.
- Summarize data in short paragraphs that include; drawing conclusions about the data; making predictions based on the data; identifying sources of error and bias in the data; Choosing appropriate summary statistics for the data (mean, median, mode)

The following resources provide interesting contexts for data comparison and analysis that can be used in this phase (senior phase): census at School – for school based surveys national surveys from Statistics South Africa (StatsSA) – for household and population surveys. International surveys from United Nations (UN Data) – for international social, demographic and environmental surveys. Many other websites may be consulted, especially for health and environmental data (Department of Basic Education, 2011), This development comes against the backdrop that in the past(post-Apartheid curriculum) statistics in South African Mathematics curriculum in the primary schools was reduced to tasks in which learners were given graphs about which simple direct questions had to be answered. Likewise the mean, median, and mode (measures of central tendency) of small data sets had to be determined according to prescribed formulas, without real understanding from the teacher's or learner's side of the role and appropriateness of and differences between these measures of central tendency (Wessels, 2008).

1.2 Factors affecting teaching and learning of data handling

As this seems to have been the case with the South African Education system, it ignored the challenges facing primary schools, like the issue of bringing in teacher with mathematics specialization in their teacher training. Data handling involves the measures of central tendency (mean, mode, median).When you have a data set it is possible to summarise the data with one single number (also called a "statistic"). The single numbers are called either measures of central tendency or measures of spread (Scheiber & Asner-self, 2011). Mean is also known as the arithmetic mean or average. To determine the mean you need to add all the scores together and then divide the sum by the number (n) of scores. We can use the formula to calculate mean:

$$\text{Mean} = \frac{\text{Sum of the total scores}}{\text{Number of scores}}$$

To calculate the mean you add the sum of all the numbers together then divide them by the sum of the scores. Mode: is the number in your data that occurs most often, you can also say the mode is the value that has the highest frequency .Sometimes two scores (or numbers occur equally often and then one mode. If there are two modes, we say that the data set is multi-modal. Other times there might not be any number that occurs more often than any other number. This means that a data set may have no mode .Median: median of data set is the number right in the middle of an ordered data set. If there is an odd number of scores, the median is the middle number. If there is an even number of scores, the two numbers will be the middle numbers. In that case, you add the two numbers of scores together and divide by two. Range: the difference between the highest value and the lowest value in a data set is called the range. Range = highest value – lowest value (Scheiber & Asner-self, 2011).

Most learners did not have problem in calculating the median and the range, their problem was with the calculation of the mean, which changed the calculation and made the mean calculation to be incorrect. This was due to non-repetition of the recurring values as follows: $12 + 11 + 13 + 11 + 14 + 12 + 13 + 13 = 99$ instead of 50 they got the as sum

of the values instead of the mean being $99 / 50 = 12,375$ or $12,4$ (correct to 1 decimal place). They also had a problem with rounding off the answer to be correct to one decimal place as per the requirement of the question, which is $= 12,4$ in their case: Ball (1990: 177) categorised that type of challenge as missing information. In their case, the missing information was the addition of all the values irrespective of whether they were recurring or not. When the learners did not add up the recurring values, they had a challenge in terms of mastering the formula for calculation of mean = sum of values / No of values: This was a challenge due to mastery of prerequisite skills, facts and concepts (Kehoe, 2002). The response to the mean calculation excluding the recurring values was not answered correctly. All this suggests some variation or hypothetical challenges / factors.

1.3 Statement of the problem

Accordingly, it is well documented that mathematics teachers all over the world need special training in order to be in a position to promote statistical literacy meaningfully in the classroom (Conference Board of Mathematical Science, 2001). Data handling and probability have been taught in tertiary education only as components of statistics. Unfortunately, in the previous political dispensation they were not taught at colleges of education, where the majority of teachers in classrooms today received their pre-service training. According to North and Zewotir (2006), in-service workshops on data handling and probability give teachers the opportunity to upgrade their knowledge so that they can teach statistical literacy to the school leaver in South Africa. AMESA organised in-service initiatives for subject facilitators or advisors, who were then expected to provide similar training to teachers; it arranged hour-long supportive talks to teachers at its annual conferences and other similar forums as well as demonstration lessons.

These stressed the significance of statistics as a problem-solving tool and demonstrated how to conduct a learner-centred and interactive statistics lesson. These teachers were given until 2010 to gain the necessary knowledge to teach the subject effectively and with confidence (DoE, 2008). Thus, there were a significant number of teachers who encountered data handling and probability for the first time when it became part of school mathematics in the FET band in 2006 (Kessel & Ma, 2002; Ahem, et al, 2000).

2. Literature Review

2.1 Student performance in Mathematics

This resulted in introduction of the Revised National Curriculum Statement in South Africa, which encouraged the notion of problem solving in teaching of data handling, and encouraged statistical reasoning. In trying to endorse the constructivist and Socio-cultural theories, the notion that constructivist researchers should be impelled in their analytical writing to be evocative of the experiences of the participants and use their own words. This motivated the researcher to involve education of other countries through Vygotsky, argument that learning occurs on a social level. The other issue being learners acquire own knowledge independently, with a particular cultural context. Also through the fact, that education in general sense is a form of learning in which knowledge, skills, and habits of a group of people are transferred from one generation to the next through teaching or research. Education takes place under the guidance of others. The socio-cultural theory also had an impact in the study's idea of roping in the education systems of other countries like Italy, Uganda, Mozambique, Pakistan, and other developing countries. This was due to the idea that this theory emphasizes the inter-dependence of social individual processes in construction of knowledge. Trying to observe the performance of learners in mathematics the study made comparison with other countries statistics education e.g. Malaysia, Uganda, Pakistan, Uganda and Mozambique.

2.2 Factors affecting teaching and learning of mathematics in South African schools

In South Africa, the teaching of mathematics seems to experience major challenges confronting educators, which are the lack of qualified teachers in the teaching of mathematics, particularly in statistics mostly in rural schools. The teaching of mathematics does not only require the teacher to have knowledge about the topic to be taught, the teacher has to be proficient in solving any problem within the topic. The teacher must be able to use mathematical knowledge to select and clarify the appropriate mathematical goals for any lesson taught (Kazima, 2008). A mathematics teacher must be able to sequence mathematical tasks into appropriate lesson designs and be able to interpret curriculum materials and explain to learners. The teacher must be able on the spot to evaluate learners explanation of mathematical worth. Kazima, (2008) view this as task of mathematical problem solving that needs to be done in teaching. They suggested that it is productive

to think about the kind of mathematical work done by teachers to problem solving enacted in the practice of teaching.

Adler and Pillay (2007) view the notion of mathematical work as being used to describe the mathematical reflection, focusing on the mathematics the teacher draws on to accomplish the tasks. They argued that Shulman views the notion of pedagogical content knowledge (PCK) as the blending of the subject matter knowledge and pedagogic knowledge and distinguishes this knowledge from what he calls "subject matter knowledge". They also suggested that Bell and co- researchers in mathematics, view detailed knowledge as entailing being able to unpack or decompress mathematical ideas so that they can be accessible to learners. In order to understand the teachers in South Africa who taught in the system after the dismantling of apartheid, it is important to have a clear understanding of the education system up to the 1990s.

3. Methodology

The researcher used the qualitative research methodology in the study. The researcher carried out this method with the intention to understand meanings, look at, describe and understand, experience ideas, beliefs, and values of teachers and learners, when observing factors affecting teaching and learning of data handling in grade 7 classes. The study tried to clarify the meaning, applied teaching strategies relevant for teaching of concepts such as mean, median, range, as these concepts seemed to be part of the challenges teachers and learners face when doing data handling

3.1 Sample size (n) and justification

The two primary schools have currently 80 learners in Grade 7 and the high school has 45 learners in Grade 8 maths classes, which are 125 learners that is population (N). There, are 94 girls and 31 boys with ages ranging between 13 and 15 years. The researcher adopted the simplified formula by (Ricketts & Wilks, 2002) for proportions to determine the sample size (n); e is the level of precision.

$$\begin{aligned}n &= N \\ 1 + N(e)/2 \\ N &= 125 \\ 1 + 125(0.05)/2 \\ n &= 1.3125 = 125 \text{ participants}\end{aligned}$$

Hence, the sample size was 125. Where, N was the population size and assuming that confidence level is 95% and level of precision in 5%. After the sample size has been determined, the participants were sampled by simple random sampling selection method.

3.2 Data Collection Methods

Data collection is a term used to describe a process of preparing and collecting data for example as the part of a process improvement or similar project. The purpose of data collection is to obtain information to keep on record, to make decisions about important issues, to pass information on to others. Primarily data was gathered to provide information regarding a specific topic.

Data was collected by means of semi structured- interviews and documentary study. (Examiners reports, chief education specialists reports, and other document on mathematics published by the Department of Education). The documentary analysis was based on:

- (1) Factors due to errors caused by incorrect association or rigidity of thinking
- (2) Factors due to errors caused by the application of irrelevant rules or strategies
- (3) Factors due to errors caused by the deficiency in mastery of prerequisite skills, facts and concepts and lastly
- (4) Factors due to errors caused by language difficulties.

3.3 Instruments

Since this is the qualitative research method the instruments used is semi- structured interview to elicit information from the respondents about the factors affecting teaching and learning of data handling.

3.4 Data Analysis

Data collected from the semi- structured interview were analysed using categorisation and thematic approach after coding and sorting

4. Discussions of Findings

The following sets of questions were categorised, according to the research question using the thematic approach.

Theme 1: Teacher factors affect the teaching and learning of data handling.

(i) Teacher's special qualification in maths

The responses of teachers to this question revealed that 11% of the educators have specialization course in maths, while the other 89% of teachers in circuit 6 of the King William's Town District have no special qualification in maths and maths teaching.

(ii) Teacher's involvement in mathematics projects aimed at training mathematics Teachers in teaching and developing materials to promote teaching of statistic (e.g. Maths for stats).

The study showed that only 22% of the teachers have ever been involved in maths teaching and training project. The interview also revealed that only 22% of the teachers in circuit 6 have ever been involved in maths teaching training project. This interview also revealed that 44% of the educators have never been involved in any maths teaching training project for the period they have been teaching maths, while 33% of the studied group did not respond to the question, which might suggest that the educators were not whether they did or not receive training

(iii) Challenges faced by learners in learning data-handling concepts such as the mean, mode, median.

The study revealed that 44% of the educators felt that the use of practical activities, would improve the level of learners understanding of the concepts mean, mode, median, and mode. 11% of the educators argued that sometimes learners understood the terms and at times did not understand them. 45% of educators did not respond to the question, which concepts like mean, mode, media, and mode they did not have solutions to these challenges.

(iv) Challenges currently faced with as educators in maths in data-handling, and the ways teachers think to use in address them.

The interview revealed that 33% of educators feel that learners struggle first and fore most with understanding the language in which maths is taught (which is English). These in turn result in them not understanding the mathematics concepts. 11% of educators felt that topics such as data handling are new and the challenge is that they never received training in them. They also suggested that the use of concrete objects (in practical activities) in teaching data handling could alleviate the problems, and make teaching easier. 22% of the educators that were interviewed acknowledged that they did have challenges in teaching data handling, as learners sometimes confused the meaning of mean, median, mode as well as the tally charts. 11% of teachers suggested they were challenged by shortage of teaching resources, which resulted in learners having trouble in counting, and better understanding of the concepts such as the mean, mode, median and the range.

Theme 2: The ways in which classroom environment affect the teaching and learning of data handling.

(i) The class size taught by the Grade7 maths teachers.

22% of educators revealed that they taught maths in Grade 7 classes ranging between 2-6 learners. 34% of educators had learners ranging between 14 - 24 learners. 44%, of educators did not respond to the question, which suggested to the researcher that it might happen that they did not have Grade7 learners this year as the circuit is situated in a deep rural area; this area is affected adversely by the relocation of parents to urban area

(ii) The school's teachers and learner's support material.

78% of educators revealed that their schools did not have enough teachers, learner support material .11% did not respond to the question, which suggested to the researcher that they were not sure whether they had enough or not of learner support materials. The other 11% responded yes they had enough teacher- learner support material.

(iii) The ways in which teachers engage the learners during the teaching and learning process of data-handling.

78% of the teachers agreed that they did engage learners during the teaching and learning process of data handling. 22% of the teachers did not answer the question, which might suggest that educators were not sure whether they did or did not engage learners during the teaching and learning process.

(iv) Teacher's reaction when learners misbehave while you are teaching.

33% of educators alluded to the fact that they discipline learners by punishing them when they misbehave during the lesson. The other 33% suggested that they draw back learner's attention by asking them questions. By giving, those interesting practical activities .22% of the educators did not respond to the question that might suggest that the

misbehaving learners did not get attention from the teachers when they did misbehave. 12percentage of the educators acknowledged that they did get disturbed when learners misbehaved during the lesson.

Theme 3: The resources that teachers are using when teaching data handling.

(i) The resources that teachers use to reflect the use of real data.

78% of the educators acknowledged that they used resources that reflect the use of real data. The other 22% of educators did not respond, which might suggest that they were not sure whether the resources they used showed use of real data.

(ii) The learner's active involvement during the teaching and learning of data handling.

56% of the educators agreed that they involved the learners during the teaching and learning of data-handling .The other 44% of educators did not respond, which might suggest that the teachers were not sure whether the learners were kept actively involved during the teaching and learning of data handling.

(iii) The use of audio-visual resources used during the teaching of data handling.

56% of the interviewed educators acknowledged that yes they did use audio-visual resources during the data-handling lessons.44% of educators did not respond which might suggest that the educators did not use the them because they were not available or if they are available they did not know how to use them effectively during the lesson.

(iv) Assistance of learners with their homework.

56% of the educators suggested that their parents with their homework assisted their learners. The other 22% suggested that their either parents or grandparents assisted learners. The other 11% of educators that did not respond to the question might suggest that, they did not know what happened to their learners after school.

Theme 4: Other factors, which affect the teaching and learning of data handling.

(i) Activities performed by learners after school.

33% of the educators responded by acknowledging that their learners play after school. While 11% of the educators suggested that their learners do homework, 33% did not respond to the question that might suggest that they did not know what activities were their learners involved in after school.

(ii) People who live with learners at home.

22% of the educators argued that learners live with their parents or with their grandparents .While the other 22% suggested that they lived either with their parents, grandparents or with their siblings. The other 22% posited that the learners lived either with their guardians or with their siblings. 22% of the educators suggested that learners lived with their parents. 11% of the teachers did not respond to the question, which might suggest that the educators did not know who their learners lived with at home.

(iii) The parents or guardians of learners work status.

22% of teachers said few of them are working. The other 33% of educators answered no the parents or guardians were not working. 11% did not respond which might suggest that they did not know whether their learner's parents are working or not.

(iv) What are the qualifications of the learner's parents?

11% of the teachers mentioned that the parents had either primary education or grade 12. While the other 33% suggested that, the parents had on educational qualifications at all. 11% of teachers suggested that the parents were illiterate. While the other11percentage suggested that the parents' qualifications were below grade12.The other 11% of teachers attested that, the parents had standard 6 or standard 8. About 11% of educators that did not respond. This might suggest that this percentage of teachers did not know their learner's parents education status.

5. Conclusion

The lack of support to mathematics teachers through workshops, in data handling. The in service training of teachers through distant learning did not show much assistance. Especially in data handling orientated concepts, and there could be a positive reform if teachers devoted more time to each of them in order to enhance student's achievement. As a country and as a continent we will need to intensify teacher development to prepare educators for the implementation of the curriculum and Assessment Policy Statement (CAPS) and pay attention to the training of principals, particularly those of underperforming schools.

To achieve quality education we need to ensure the provision of sound infrastructure. ASIDI adds focus and momentum to the Department's Action Plan to 2014 and the goals of schooling 2025.The main goal of ASIDI is to eradicate mud and unsafe structures and to provide improved resources, such as laboratories, and administration blocks to existing schools. In the South African context the issue of high unemployment coupled with a widely recognised skills shortfalls, giving South Africans a better educational start in life will reduce poverty. It is for this reason that access to

quality education features strongly in all election manifestos of the ruling party and why education has been identified as a priority amongst progressive South Africans.

6. Recommendations

On the basis of the findings above, and general expectations are considered necessary provision of workshops to teachers by subject advisors and continuous visits by them to various schools for support. A wide community including employers should be empowered to take more ownership of all aspects of the mathematics curriculum.

Greater attention should be paid to the needs of larger number of students who currently learn very little useful mathematics. Major innovation is needed to develop a provision that meets the diverse needs of all our students and not just the most talented. The attainment of Students in top performing countries presents a target that we should aspire to reach. Adu (2012) suggested that there is a strong view among problem based teaching experts that problem based learning is a basic human learning process. (Cohen & Manion, 2007 and Wessels, 2009) observed that whenever a person is confronted with a problem, somewhat familiar, and solution process is easily recalled as well as more efficiently handled, than one were told about the initial problem and its solution to problem and its solutions process.

Adu (2012) recognised the numerous benefits which problem-based learning strategy offers on studies such as. Requiring students to constantly put their knowledge to work. Promote the means for organizing knowledge around key theoretical and practical ideas. Focusing on true understanding, and the provision or requisite intellectual rigor that is more meaningful to both scholarship and the world of affairs than that which could be achieved from memory based learning. Each school should have the responsibility for adopting or creating its own mathematics programme. The circuit should inform this, district and provincial programmes. Pupils learning should be reported to parents in relation to the school's curriculum and their progress towards the stationary outcomes for the end of primary schooling. Particular attention should be given to initial teacher training as well as in service training. As the lack of suitably qualified mathematics teachers impacts badly particularly on lower attaining children.

References

- Adler, J (2000) Conceptualising resources as a theme for teacher education. *Journal of Mathematics Teacher Education*, 3,205-224
- Adu, E.O (2012): Two problem based learning Strategies for teaching Economics. An action Research Paradigm shift. LAP LAMBERT Academic publishing. Germany.
- Ahern, T.C., Jamison, M. & Olivarez, A. (2000). *Designing the next generation of tools using an open systems approach: A usability study*. ERIC Documentation Reproduction Service No ED444585.
- Babbie, E. & Mouton, J. (2003) the practice of social research. Cape Town: Oxford University
- Ball, D.L. (1990). Breaking with experience in learning to teach mathematics: The role of a pre-service methods course. *For the Learning of Mathematics*, 10(2), 10–16.
- Cohen, L & Manion, (2007). An Ethical Approach to Practitioner Research, New York community of practice: the centrality of confidence. *Educational Studies in computer tools*. Doctoral dissertation. Utrecht: CD-β Press.
- Conference Board of Mathematical Sciences (CBMS). (2001). *the mathematical education of teachers*. Providence, RI and Washington, DC: American Mathematical Society and Mathematical Association of America.
- CREATE. (2008). Educational Access in South Africa: Country Policy Brief. Johannesburg.
- De Bock D, Van Dooren W, Jansen D & Verschaffel L (2002). Improper use of linear reasoning: An in depth study of irresistibility of secondary schools
- Department for Education and Skills (DfES). (2003) Curriculum and Staffing Survey. Retrieved September 12, 2005 from <http://www.dfes.gov.uk/statistics/DB/SFR/>
- Department of Basic Education. (2011). Action Plan to 2014: Towards the realisation of Schooling 2025. Government Notice 752 of 2010.
- Department of Basic Education. (2010). Education Statistics 2008. Pretoria: Government Printers.
- Department of Education (2008). Intermediate phase policy document. Pretoria, South Africa.
- Department of Education (2010). Education for all, 2009 country Report: South Africa. Pretoria.
- Department of Education. (2009). Report of the Task team for the Review of the Implementation of the National Curriculum Statement Final Report.
- Department of Education Republic of South Africa. (2011). *Curriculum and Assessment Policy Statements (CAPS)*.
- Department of Education. (2008). *National curriculum statement Grades 10–12, development*. Policy Briefs. Rutgers, University of New Jersey.
- Garet, M., Porter, A., Desimone, L., Birman, B., & Yoon, K. (2001). What makes
- Gattuso, L. (2006). *Statistics and Mathematics Is it possible to create fruitful links*. In Rosman, & B. Chance (Eds) Salvador Brazil. Proceedings of the Seventh International Conference on teaching of Statistics.

- Kazima, M (2008): Mathematics for teaching: *Observations from two case studies South Africa Journal of Education*: Vol 28: 283-299
- Kehoe, J. (2002). *Basic item analysis for multiple choice tests*. Washington, DC: ERIC Clearinghouse on Assessment and Evaluation, the Catholic University of America. (ERIC Document Reproduction Service No. ED 398237)
- Kessel, C. & Ma, L. (2000). *What we think that elementary teachers need*. National Council for Teaching Mathematics. Retrieved September 2, 2005 from <http://www.nctm.org/dialogues/2000-10/whatwe.htm>
- Khan, S.B. & Christie, S (2011). Learners 'errors: supporting learners for participating in Mathematics classroom, *International Journal of Academic Research*, 3(1) Part II: 655 – 658.
- North, D., & Zewotir, T. (2006). Introducing Statistics at school level in South Africa. In A. Rossman & B. Chance (Eds.), *Proceedings of the 7th International Conference on Teaching Statistics* [CD]. Voorburg, the Netherlands: International Statistics Institute.
- Papariotodemou, E., & Meletiou-Mavrotheris, M. (2008). Developing young students' informal inference skills in data analysis. *Statistics Education Research Journal*, 7(2), 83-106, Retrieved March 08, 2009, from [http://www.stat.auckland.ac.nz/~iase/serj/SERJ7\(2\)_Papariotodemou.pdf](http://www.stat.auckland.ac.nz/~iase/serj/SERJ7(2)_Papariotodemou.pdf)
- Radatz, H. (1979). Error Analysis in Mathematics Education. *Journal for Research in Mathematical Education*. 10 (3), 163-172
- Republic of South Africa (2010). 2010 Millennium Development Goals. Country Report. South Africa. Pretoria
- Ricketts, C. & Wilks, S. (2002) Improving student performance through computer based assessment: Insights from recent research. *Assessment and Evaluation in Higher Education*, 27(5), 475-479.
- Scheiber, J and Asner –self, K (2011). *Educational Research*. Hoboken: John Wiley & Son Incl.
- Statistics South Africa. (2010). General Household Survey Interactive Data sets .Pretoria: Stats S.A.
- Vygotsky, L. (1989). *Thought and Language*. Newly revised and edited by Kozulin Massachusetts Institute of Technology .Holiday Lithography.
- Wessels, H.M. (2008). *Statistics in the South African School Curriculum*: content, assessment, and teacher training. In C. Batanero, G. Burril, C. Reading, & A. Rossman (Eds). *Proceedings of the 18th (CMI study conference and 2008 IASE Round Table conference*, 30 June -04 July.
- Wessels, H.M. (2009). Effective teaching and learning of Grade 8 and 9 statistics. Unpublished post-doctoral research report, North-West University, Potchefstroom, South Africa.