

Impact of the Mathematics Lesson Structure reform in Seychelles on pupils' achievement

Justin Valentin

King's College London

This paper draws on secondary achievement data and describes the pupils' achievement during the first years of a mathematics teaching reform. Cross sectional analyses of the data showed no improvement in performance during the first years of the reform. However, during the same period, variations in the pupils' scores reduced. The fact that it is difficult to make claims about impact of reform in the absence of experimental data, findings reported in this paper have become a rationale to extend these analyses beyond the descriptive statistics to include data from other sources.

Keywords. Mathematics lesson structure, achievement, mathematics teaching reform, Seychelles.

Introduction

In 2003 in Seychelles, the Ministry of Education decided that improving pupils' learning in mathematics be one of the main priorities in its five-year plan (Ministry of Education, 2003). The decision followed claims of weak pupils' achievement in mathematics (Khosa, Kanjee, and Monyooe 2002; Ministry of Education 2003; Trencansky 2002; Valentin 2003). A Mathematics Working Group (MWG) was mandated to spearhead all improvement activities around the subject. A systemic project, the Improving Pupils' Achievement in Mathematics (IPAM) project, was inceptioned. A school survey conducted in 2004, with evidence from informal interactions with teachers suggested teaching as the area requiring improvement (Benstrong, Theresine, and Albert 2004). Stimulated by the three-part lesson structure from the National Numeracy Strategy in UK (DfEE 1998), as analysed in the Leverhulme project report (Brown, Askew, Rhodes, et al. 2003), the MWG in Seychelles initiated a mathematics teaching improvement reform, known as the MLS – the Mathematics Lesson Structure. Elsewhere, (Valentin 2011) I have described the reform along with findings relating to the teachers' impression during the first years. The reform is underpinned by the assumption that teachers' processes determine pupils' achievement in the classroom (Darling-Hammond 2000). This paper reports on the analysis of two secondary datasets, an exploration of the pupils' achievements before and during the early years of the reform.

Lesson Structure

The specific teaching process which MLS reform sought to improve is the teachers' lesson structure. Schmidt, Jorde, Cogan, et al. (1996) contend that lessons within a country generally take a common form. The term characteristic pedagogical flow is coined to describe the general pattern of lessons of a particular country (Schmidt, Jorde, Cogan, et al. 1996). CPF springs from socialization of practices and cultural

values of education (Biggs 1998). If lesson pattern – lesson structure in the Seychelles’ context – is a result of teachers’ experience, values, and socialization, and if this lesson pattern can permeate a system, then it is possible to interfere with a country’s pedagogical flow. The MLS reform attempted that. Its consequences are yet to be established. The whole notion of lesson structure as in the MLS reform relates to coherence and encompasses sequencing. Instructional coherence is defined as linked events and the meaningful discourse reflecting the connectedness of topics, which benefits students’ learning of mathematics (Chen and Li 2010). The use of the metaphor, “a good mathematics lesson is like a story” indicates the significance of coherence in developing lessons (Hiebert, Stigler, and Manaster 1999). The lesson is organized such that each sequence of events or activities becomes interconnected such that the ‘story’ gets a beginning, a development, an ending, and a consistent theme that runs throughout (Fernandez, Yoshida, and Stigler 1992). Using story as the metaphor also entails that lessons have climax and coherent storyline (Shimizu 2009) – two features which were often missing in the overall conduct of mathematics lessons in Seychelles prior to the reform (Benstrong, Theresine, and Albert 2004).

In this paper, I draw on secondary achievement data and I present a description of the pupils’ achievement before and during the early years of the reform. The nature of the data makes it possible to conduct cross sectional analyses of the pupils’ achievement. Now I turn on to describe the datasets used for this paper.

Data and analysis

I analysed secondary data from the SACMEQ II and III data archives. SACMEQ (Southern African Consortium for Monitoring Educational Quality) is an association of fifteen Ministries of Education in Africa working together on improving different aspects of education using research evidence. Under the auspices of the International Institute of Educational Planning in Paris, SACMEQ has carried out three major surveys in its member states. The SACMEQ works are comprehensively described in (Murimba 2005). The SACMEQ data are relevant in this study in that the two mathematics surveys in which Seychelles took part were done before and after the reform, hence, permits comparison of pre and post reform achievement pattern. The data set provides an opportunity to study the relationship between MLS reform and pupils’ achievement. For this paper, I computed descriptive statistics for the two mathematics achievement datasets. I conducted ANOVA on the results. Then I worked out the percentages of pupils attaining each competency level. Lastly, I compared the pupils’ performance on the common items of the two tests.

An overview of the test construction

The SACMEQ tests were constructed by the national coordinators representing each member country. To ensure content validity, the curricula of the different countries were reviewed and common topics were identified. A blueprint was developed and items were written on the basis of the common topics. Finally one test, common to all participating countries, was prepared. The test included “overlapping” items selected from the earlier SACMEQ studies (Ross et al. 1998) and the IEA’s Third International Mathematics and Science Study (TIMSS) (Mullis et al. 2001).

Results of the analysis

The first analysis compared the basic descriptive statistics of SACMEQ II and III data. Since MLS became mandatory in May, 2006 and SACMEQ III was administered in October 2007, I have reason to describe the pupils' achievement of the third SACMEQ administration as post reform learning outcomes. The SACMEQ III mathematics test was equivalent to SACMEQ II test hence their results could be compared. SACMEQ II test consisted of 63 items and SACMEQ III consisted of only 49 items. The decision to add or remove items on the tests was made by the SACMEQ coordinating centre based on their analyses of pupils' performance in SACMEQ II. Of the 63 items of the SACMEQ II, 47 (representing a total of 75%) were repeated on SACMEQ III test. The 49 items of SACMEQ III means that 96% of its items were items of SACMEQ II. This allows cross sectional analyses to be done on the test results. The number of candidates who sat SACMEQ II and III mathematics tests are 1484 and 1480 respectively.

The mean of SACMEQ II test was 47.96% and standard deviation 16.84. These two statistics for the SACMEQ III tests are 46.36% and 14.78 respectively. Numerically both the mean and the standard deviation have gone down in the SACMEQ III results (see Table 1). ANOVA conducted on the two sets of scores suggests that the mean for the 2007 result was significantly lower than the 2000 mean [$F(1, 2962) = 7.54, p < 0.01$]. Comparison of variations of scores using the coefficient variation indices show that the value went down from 35% to 32% suggesting that the group became more homogeneous after the reform. Coefficient of variation is the ratio of the standard deviation to the mean and is numerically useful to compare variations among groups with different means.

Matching the items of the two tests and comparing their item difficulty indices (item means) revealed that, a) of the 47 items common to both the SACMEQ II and SACMEQ III, 26 (55%) items of the SACMEQ II test had a better mean than items of SACMEQ III test. The means were common for only 6 (13%) of the items. This implies that the 2007 cohort did better on only 32% of the common items.

Analysis of the nature and content of the items on which the 2007 cohort was better than the 2000 cohort revealed that the items could be grouped into three categories mainly. The first category were the identification items such as, identifying properties of shapes and smallest numbers from list. This category consisted of items which generally do not require mathematical manipulations to work out the answer. The second category contained matching and graph readings. Here again there was little mathematical computation or manipulation involved. The third category included items which required some elements of computation but could be done in one step.

A similar item skill auditing was done on those items onto which the 2000 cohort was better. The items functioned at a higher cognitive level. They included items requiring the pupils to: read and interpret graphs; convert units of measurement and fractions; apply rules to solve problems; and compute solutions using no less than two steps. In a third analysis I compared the percentage distribution of students over the eight competency levels of numeracy. The following results were obtained: i) the percentage of pupils at the lower levels (1 and 2) had decreased from 2000 to 2007; ii) in 2007, the percentages of pupils attaining the top level (7 and 8) have decreased; and iii) only 31.3% of the pupils have achieved Level 5 or better in SACMEQ III results. Findings reported in this paragraph can also be found in Table 1.

Descriptions	SACMEQ II 2000	SACMEQIII 2007
No. pupils	1484	1480
Mean (%)	47.96	46.36
Standard deviation	16.84	14.78
Coefficient variation (%)	35	32
Percentage pupil at Level 1	2.6	1.9
Percentage pupil at Level 2	20	15.9
Percentage pupil at Level 3	24.2	24.5
Percentage pupil at Level 4	19.7	26.4
Percentage pupil at Level 5	13.8	14.4
Percentage pupil at Level 6	13.3	13.2
Percentage pupil at Level 7	5.0	2.4
Percentage pupil at Level 8	1.4	1.3

Table 1: Basic statistics for the three tests

Discussion and conclusion

The findings indicate that while pupils' achievement showed no improvement during the early years of the reform, variations in the pupils' scores decreased over the same period. This leads me to claim that the method of teaching advocated in MLS tends to bring pupils together. In UK, where the idea of inducing a lesson structure in school originated, it was observed that such prescribed method of teaching to some extent did push up achievement a little bit (Brown, Askew, Millett, et al. 2003). MLS case in Seychelles did not improve achievement during the early years. However, while in the Seychelles' case a decrease in variation was observed, the national numeracy scenario in UK showed an increase in variability of scores (Brown, Askew, Millett, et al. 2003)

On the basis of the evidence presented in this paper, I can argue that some aspects of the MLS approach to teaching can be an appropriate teaching strategy to deal with mixed ability teaching – an approach which is gaining prominence following findings from local research in schools (Leste 2005). Here I use the term some aspects of the MLS since data which I have in relation to teachers' enactment of the reform revealed that some components of the reform are not being used as expected (Valentin, 2011). This observation may also imply that the needs of some pupils, in particular, the top performers, are not being taken care of. Observation of classes which I did in a different phase of the research showed that in many instances the pupils' tasks were not challenging. This study opens more spaces for research into the teaching of mathematics in Seychelles under the MLS regime.

References

- Benstrong, E., A. Theresine, and C. Albert. 2004. Instructional Practices: Push and Pull. Paper presented at the *6th Annual National Education Conference*. Seychelles.
- Biggs, J. 1998. Learning from the Confucian heritage: so size doesn't matter? *International Journal of Educational Research* 29 (8):723-38.

- Brown, M., M. Askew, A. Millett, and V. Rhodes. 2003. The key role of educational research in the development and evaluation of the National Numeracy Strategy. *British Educational Research Journal* 29 (5):655-67.
- Brown, M., M. Askew, V. Rhodes, H. Denvir, E. Ranson, and D. Wiliam. 2003. Characterising individual and cohort progression in learning numeracy: results from the Leverhulme 5-year longitudinal study. Paper presented at American Education Research Association Conference. Chicago, April 21-25, 2003
- Chen, X, and Y Li. 2010. Instructional coherence in Chinese mathematics classroom - A case study of lessons on fraction division. *International Journal of Science and Mathematics Education*:8 (4): 711 - 35.
- Darling-Hammond, L. 2000. Teacher quality and student achievement: A review of State policy evidence. *Education Policy Analysis Archives* 8 (1). 1-44. Retrieved from <http://epaa.asu.edu/ojs/issue/view/8>.
- DfEE. 1998. *The Implementation of the National Numeracy Strategy: The Final Report of the Numeracy Task Force*. London: DfEE.
- Fernandez, C, M Yoshida, and JW Stigler. 1992. Learning Mathematics From Classroom Instruction: On Relating Lessons to Pupils Interpretations. *Journal of the Learning Sciences* 2 (4):333-65.
- Hiebert, J, JW Stigler, and AB Manaster. 1999. Mathematical features of lessons in the TIMSS Video Study. *ZDM* 31 (6):196-201.
- Khosa, G, A Kanjee, and L Monyooe. 2002. *The Seychelles School Improvement Programme: Baseline Evaluation*. Pretoria: Human Science Research Council.
- Leste, A. 2005. Streaming in Seychelles: From SACMEQ research to policy reform. Ministry of Education. 2003. *Report of Primary Six National Mathematics Examination Report for the Year 2002*. Victoria, Seychelles: Ministry of Education.
- Mullis, IVS, MO Martin, E. Gonzalez, KM O'Connor, SJ Chrostowski, KD Gregory, RA Garden, and TA Smith. 2001. *TIMSS 1999 benchmarking mathematics report*. Chestnut Hill, MA: Boston College-TIMSS and PIRLS International Study Center, Retrieved from: <http://timss.bc.edu/isc/publications.html>.
- Murimba, Saul. 2005. The Impact of the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ). *Prospects* 35 (1):91-108.
- Ross, KN, T. Machingaidze, P. Pfukani, and S. Shumba. 1998. The quality of primary education: some policy suggestions based on a survey of schools: Zimbabwe. *SACMEQ policy research: report No 3*.
- Schmidt, W.H., Jorde, D., Cogan, L.S., Barrier, E., Gonzalo, I., Moser, U., Shimizu, K., Sawada, T., Valverde, G.A., McKnight, C., Prawat, R.S., Wiley, D.E., Raizen, S.A., Britton, E.D. and Wolfe, R. (1996) *Characterizing pedagogical flow: Characterizing Pedagogical Flow: an investigation of mathematics and science teaching in six countries*. Dordrecht London: Kluwer
- Shimizu, Y. 2009. Characterizing exemplary mathematics instruction in Japanese classrooms from the learner's perspective. *ZDM* 41 (3):311-18.
- Trencansky, I. 2002. Consultant Slovaque du ministère de l'éducation de la république des Seychelles. Rapport final de la mission. Victoria: Ministry of Education, Seychelles.
- Valentin, J. 2003. *Proficiency on Arithmetic Word Problems of Seychellois Pupils*. Unpublished master thesis, School of Educational Studies, University of Science Malaysia, Penang, Malaysia.

- . 2011. Primary school teachers in Seychelles reporting on their impressions of a mathematics teaching reform. In Smith, C. (Ed.) *Proceedings of the British Society for Research into Learning Mathematics* 31(1):137-43.