

Teachers' Reflections on their Implementation of a Revised Primary Mathematics Curriculum

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Abstract

This quantitative research involves the use of a questionnaire to capture the teachers' reflections on six areas for implementing a primary mathematics curriculum: *Personal Attributes; Teaching Methods; Classroom Learning Environment; Classroom Management and Control; and Assessment and Feedback*.

Thirty-seven teachers from 15 primary schools across two parishes participated. Their reflections indicate that they are aware of their own abilities and shortcomings to effectively deliver the mathematics curriculum. The teachers continue to employ traditional methods, but consider themselves to have a pleasing personality for working closely with primary students, and to be good at *Managing and Controlling the Classroom*. There is room for improvement in the *Methods for Teaching* and the techniques for *Assessing* students' understanding. Other factors that negatively impact the implementation of the curriculum relate to school administration, the curricular content, and students' disposition towards mathematics.

The findings have implications for contexts and practices for implementing a revised (primary) mathematics curriculum.

Keywords: Classroom practices; teaching quality; reflection

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This paper reports on selected aspects of an evaluative research on teachers' classroom practices for teaching Grade 4 mathematics in selected primary schools in Jamaica, and the implications for teaching quality.

1 Introduction

Given the importance of mathematics in an ever-changing competitive global environment, the core goal of (primary) mathematics education is to meet the needs of all students for effective functioning in society (English, 2008; Jamaican Ministry of Education, 1999). The perception teachers hold of their classroom practices and their abilities to implement a mathematics curriculum as intended influence students' performance in the subject, and their disposition for learning the subject. (Ernest, 1989; Thompson, 1992)

Mathematics is a dynamic subject with abstract ideas, and the effective delivery of its content places many demands on the teachers. In addition to having the subject-matter knowledge and pedagogical knowledge skills, confidence and dexterity are essential characteristics that teachers ought to possess in order to effectively implement the curriculum (Williams, 2008). According to Ball, Hill and Bass (2005), teachers need to *know mathematics for teaching* which demands more than being able to carry out the algorithm reliably. They further explained that many of the tasks of teaching involve mathematical reasoning as well as pedagogical thinking. In other words, in order for the teachers to facilitate meaningful learning for the students, the teachers have to figure out where the students have gone wrong (error analysis), explain the basis for an algorithm in words that the students can understand and show why it works, and use mathematical language and representations appropriately.

Teachers are key players in the classrooms. They have a powerful long-lasting influence on their students. They directly affect the processes that are involved in student learning and how students relate to others within and outside of school (Strong, 2002). The effective implementation of Standards and curricula depends on the knowledge, skills, attitudes and competencies of the teachers, and their abilities to use appropriate instructional materials and assessment tools (Ball, Hill & Bass, 2005).

Davis (2004) and Williams (2008) suggest that much of the failure in mathematics among Jamaican schools is due to inappropriate teaching methodologies. Ball, Hill and Bass (2005) shared similar views about performance among schools in the United States. They opined that teachers were failing to reach reasonable Standards of mathematical proficiency with most of their students.

Teachers are being blamed for their students' low attainment in mathematics, yet they are afforded few opportunities, if any, to voice their reflections on their own classroom practices for teaching the subject. This study thus sought to explore some Grade 4 primary teachers' reflections for implementing a revised mathematics curriculum.

2 Rationale for the study

In Jamaica, the National Primary Mathematics Curriculum was revised in 1999 to raise the Standard

of mathematics teaching and student performance in the subject. This was done at a time when emphasis was on engaging students in the construction of their own knowledge and understandings; to reflect the learning theory of Constructivism. Although the curriculum is somewhat dated, its content articulates with current reform processes. The curriculum promotes the use of a variety of teaching strategies and activities to develop independent learners, promotes higher-level thinking skills in the students, and facilitates students in noting the integration of mathematics across other curricular areas. To this end, teachers are encouraged to engage the students in interactive mathematics by integrating technology across the curriculum, making use of manipulative materials, engaging the students in cooperative learning groups, and promoting discourse among students and teacher.

Despite the many promotions to engage in models of teaching that articulate with the principles of constructivism, the Task Force on Educational Reform, Jamaica in its 2004 report revealed shortcomings in the educational system that

“Despite high enrolment rates, significant curriculum reform and other efforts, performance at all levels of the system has been well below target as measured by student scores on national and regional assessments and performance in relation to the critical minimum targets set out in the White Paper of February 2001” (p. 41).

In her report on primary and secondary education in Jamaica, Williams (2008) indicated that

“Educational performance remains a challenge as despite high levels of enrolment at the primary and lower secondary levels of the system, there is still a concern about the quality of education which is provided.” (p 6).

These reports and the research findings indicate that many classroom teachers in Jamaican schools are failing to implement the mathematics curricula as intended. Observations from the New Horizon Project (2004), a joint initiative of the Jamaican Government and the United States Agency for International Development (USAID), indicated that primary school mathematics was taught in traditional ways: the teachers were tellers, they did examples on the chalkboard and then had the students follow with exercises (Juárez & Associates, Inc., 2004). The lessons were textbook-oriented and there was no room for students to develop relational understanding of mathematical procedures. Juárez and Associates, Inc. (2004) were of the view that the teachers themselves had not developed relational understanding of the mathematical concepts. Their interviews with teachers of the New Horizon Project indicated that the teachers were either ill-prepared or uncomfortable teaching some strands in the Revised Primary Curriculum. Such strands included: probability and statistics, geometry, algebra and measurement.

In light of the aforementioned findings and the goals of the Revised Primary Mathematics Curriculum, this study sought to explore the teachers' own reflections on their classroom practices for quality teaching of Grade 4 (primary) mathematics. Additionally, the study sought to gain an understanding of the factors the teachers consider to influence their teaching of primary mathematics.

3 Research questions

- 1) What are the Grade 4 teachers' reflections on their practices for implementing a revised primary mathematics curriculum, based on given criteria of quality?

- 2) What are the common problems that the selected teachers indicate that they encounter in the teaching of Grade 4 mathematics?

4 Significance of the study

Primary mathematics should lay the foundation for further learning of the subject. This suggests that measures should be in place to ensure that (primary) teachers' classroom practices for teaching mathematics articulate with the goals of the curriculum for quality teaching. Based on the findings, stakeholders may wish to consider possible actions to take to revise policy and/or the curriculum, and to remedy any inappropriate practices in the mathematics classroom in order to enhance student learning of the subject. The findings will add globally to the existing literature and contribute to meaningful debates and discussions about primary mathematics education globally, and the role teachers play in contemporary mathematics education.

5 Key Terms

- **Classroom practices:** These are the thoughts and actions of teachers within the contexts of the classroom, which manifest from the teachers' knowledge, values, beliefs and attitudes.
- **Reflection on classroom practices.** The processes of analysing and evaluating one's practices in the classroom for the teaching and learning of mathematics.
- **Teaching quality:** The extent to which practices or features reflect some Standard acceptable measures of performance or characteristic. In other words, the elements of teaching that compare with a set of known effective practices that ultimately lead to student learning.

6 Review of related literature

This research is underpinned by two theories: the **Theory of Constructivism**; and the **Theory of Reflection**. The study involves the voices of primary teachers about their reflections on their practices for teaching mathematics.

The Theory of Constructivism

The learning theory of Constructivism is based on the premise that persons construct their own knowledge and understandings from their experiences in social or cultural settings (Vygotsky, 1978).

As Constructivism became established as an epistemology of mathematics education, changes in the classroom practices for teaching mathematics were promoted. Classrooms that reflect the principles of Constructivism are characterised by certain features. In these settings, the teachers' roles are those of facilitators in which the teachers link new knowledge with students' prior experiences, promote higher-order thinking and problem-solving and encourage discourse among the students and between teachers and students (Brook & Brooks, 1993; Nickson, 2004; Orton, 2004). Drawing on Fuson, Carrol and Drucek's (2000) description, in contrast to traditional methods of rote learning and practice of skills, students

construct meaning of the mathematical concepts and procedures and engage in meaningful problem-solving activities. This mathematical knowledge is facilitated by teachers who plan and prepare lessons, elicit, extend and support students' mathematical thinking, promote discussions, use meaningful representations of mathematical concepts and encourage use of alternative solutions. Overall, mathematics teaching engages the students in interactive mathematics with a view to developing mathematical understandings.

The Theory of Reflection

The conception of 'reflection' dates as far back as 1933 with the works of Dewey (1933) who recognised that reflection is a necessary component for effective leadership and practice based on the assumption that problems will arise in any setting, and the processes for resolving the problems provide the opportunities for professional growth. The tenets of Dewey's theory of reflection relate to four distinct areas that Rodgers (2002) has identified as follows:

- (a) reflection is a meaning-making process which provides the opportunities for the individuals to develop a deeper understanding of their experiences and their relationship to those of others;
- (b) reflection is a mode of thought that is rigorous and disciplined;
- (c) reflection needs to happen in a community in interaction with others; and
- (d) reflection requires attitudes that value the personal and intellectual growth of oneself and of others.

Teachers as Curriculum Implementers

Teachers are expected to be implementers of both the curriculum and the policy that governs teaching and learning at an institution (Croll, Abbott, Broadfort, Osborn & Pollard, 1994). Even though research has established that the teachers' beliefs and attitudes impact their instructional practices, it has also been argued that the successful implementation of any curriculum depends on the social context of the school and on the teachers' abilities and competencies to interpret the curriculum, to plan appropriate lessons and to deliver the intended curriculum (Mohammed & Harlech-Jones, 2008).

Research findings suggest that teachers seldom implement a (mathematics) curriculum as stated in the curriculum documents because of the societal demands and the many teacher-related issues that emerge in the (mathematics) classrooms (Gates, 2006; Mohammed & Harlech-Jones, 2008; Yum-peng, Chi-chung and Ngai-ying, 2006). The findings of the case study of Yum-peng, Chi-chung and Ngai-ying (2006) supported this argument. In their case study of two primary schools in North-East China the researchers sought to explore the implementation of the national primary mathematics curriculum in two different types of primary schools. These schools differed with respect to location (one rural and the other urban), school size, academic Standard of students and availability of resources. The findings revealed that the mathematics teachers had a strong influence on the way the subject was planned and delivered at the instructional level. Their decisions on curriculum matters were shaped by their professional knowledge and educational beliefs. The researchers noted some similarities in the instructional practices of the teachers but they also noted some differences in the practices. Both schools placed an emphasis on preparing the

students for the national high-stakes examination and used the prescribed textbook in a particular content sequence. Even though there were common planning times among teachers of the same grade level, the differences in practices stemmed from the teachers' ways of preparing their lessons, their interpretations of the central curriculum requirements, their views on how mathematics should be taught and learnt, the collegiality among staff, and the expectations of the parents and school administration. (Yum-peng, Chichung & Ngai-ying, 2006).

Although the findings of a qualitative research should not be generalised, it seems reasonable to suggest that the foregoing situations could exist in other primary schools. Indeed, teachers as curriculum implementers determine the classroom experiences for students and areas of the intended curriculum that are delivered. In the Jamaican educational system, the school culture seems to strongly impact the classroom context.

Classroom practices

Classroom practices are all the activities that the teachers engage in within the social and cultural setting of the classrooms to facilitate learning by the students. In other words, they are the activities in which the teachers' intentions are made public or to use

Jackson's (1968) expression, "the life that the teachers create in the classrooms". Classroom practices therefore include the environment for learning that the teachers create that are characterised by their styles, whether authoritative or non-authoritative; the teaching strategies or approaches that are used; the assessment tools that are selected and used; the discerning qualities that are demonstrated; the rules and regulations that are explicitly or implicitly implied by the teachers' actions; the interest (or lack thereof) for the students and responsiveness to them; and the passion, poise, enthusiasm (or lack thereof) for teaching that are demonstrated (Kyriacou, 2009).

Teachers as reflective practitioners

It is well-recognised that mathematics classrooms are dynamic and complex and are composed of individuals with diverse cultural and social backgrounds, beliefs, values and attitudes towards mathematics. In the mathematics classrooms, situations may arise for the teachers to engage in critical self-reflection of their classroom practices in order to facilitate learning, manage the classroom and meet the academic, social and emotional needs of the students (McLaughlin, 1999). In other words, the teachers may be required to engage in reflective practice.

For teachers, this kind of reflective thinking either during class or after class, provides the opportunities for them to examine their beliefs, past experiences, assumptions, instructional practices, expectations, feelings and moods, personal agenda and aspirations, in solving problems and in responding to classroom situations and individual student behaviours (Larrivee, 2000). The processes of reflective thinking thus provide avenues for interpreting and acting on experiences in the classroom with the goal of improving practices.

Schön's (1987) interpretation of "reflective practice" is extensively documented in the literature and differs somewhat from that of Dewey. Unlike Dewey, who regarded "reflective practice" as a means of solving "structured" problems, Schön (1987) regarded problems of real-world practice as involving "messy,

indeterminate situations..." (p. 4). Schön (1987) was of the view that during professional (instructional) practices, situations may arise in the classroom that are uncertain, unique and value conflict, and which the teacher is required to address. He also opined that for such situations, there is no clear cut theory, technique or technical means (Dewey, 1933 described this as technical rationality) for addressing the situation. The teacher has to now respond to the situation and devise appropriate strategies to ultimately benefit the students.

"Reflection-in-action" and "reflection-on-action" are two ideas that Schön (1987) expressed that teachers engage in when they reflect on their own classroom practices. Reflection-in-action occurs during the actual teaching whereas reflection-on-action occurs after teaching takes place. However, both ideas have the same goals of effective teaching and meaningful learning. Teachers are encouraged to become reflective practitioners (Schön, 1987). As reflective practitioners, teachers are able to assess events and experiences in the classroom with a view to making adjustments for teaching as they see fit. This type of reflection promotes a continuous consideration of beliefs and assumptions about (mathematics) teaching and learning in order to improve instruction.

Osterman and Kottkamp (2004) have pointed out that school reform (including mathematics education reform) and professional development cannot be achieved unless educators engage in reflective practice. For them, change begins with individuals, and meaningful change can only occur when individuals examine their assumptions and practices.

7 Methodologies

7.1 Gaining Entry

The researcher approached the Principal or Vice-principal at 15 primary schools in the parishes of Kingston and St. Andrew, for their permission to collect data from their Grade 4 teachers. These schools were purposively and conveniently selected.

The researcher left the teacher- questionnaire with the teachers to complete and collected the completed form after a period of two-weeks.

7.2 Participants

Data were collected from 37 (Grade 4) primary teachers across 15 schools in Kingston and St. Andrew. The demographic information about these teachers is given in Table 1.

7.3 Instruments

The quantitative methodology that was employed involved the use of a teachers' questionnaire with an open-ended section to capture the teachers' reflections on their classroom practices for teaching (Grade 4) mathematics, and the factors they consider to impact their teaching of the subject.

The teachers' questionnaire was made up of four sections: Sections A, B, C and D. The 30 items in Section B related to the teaching of mathematics, and the teachers were required to evaluate their own teaching and classroom practices on a five point Likert scale. For this section, six areas or indicators of

teaching were explored: personal attributes (4 items), lesson planning and preparation (4 items), teaching methods (10 items), classroom learning environment (4 items), classroom management and control (4 items), and assessment and feedback (4 items). The minimum and maximum scores that could be obtained in this section were 30 and 150 respectively.

8 Validity, reliability and bias

Validity, reliability and bias are important concepts in quantitative research. All the necessary steps for instrumentation, data analyses and interpretations were observed. The categories and items on the questionnaire were carefully selected to ensure that the items measured what they were intended to measure (validity), and that the outcomes would be the same should the research be duplicated (reliability). Elements of bias were avoided.

9 Findings and Discussions

In this section, the teachers' responses on items on the questionnaire that relate to their teaching of (Grade 4) mathematics and classroom practices for teaching the subject are given.

Research question 1

What are the Grade 4 teachers' reflections on their practices for implementing a revised primary mathematics curriculum, based on given criteria of quality?

The scores of the teachers' responses on the Likert scale for the self-evaluation of their teaching and classroom practices are shown in Table 2.

Personal attributes

Ninety-two percent of the teachers viewed themselves as being attentive to their students; 95% indicated that they cared for their students and 97% indicated that they were interested in their students and were willing to listen to them.

Preparation and planning

Seventy-six percent of the teachers considered themselves to be ready for mathematics classes with the necessary materials and planned all the activities for the students to do during mathematics classes. Additionally, 97% of the teachers were always sure of what they wanted their students to do during the mathematics classes.

Overall, the teachers had positive opinions about their classroom practices for teaching Grade 4 mathematics. Even though 97% of the teachers indicated that they knew what they wanted their students to do during the mathematics classes, 32% of the teachers indicated that they were ill-prepared with the items that they needed for the lessons.

For the qualitative open-ended-section, the teachers in the survey indicated that they faced some

challenges in planning and preparing their lessons for teaching (Grade 4) mathematics, and expressed some concerns in using the curriculum document. They opined that

"Lesson planning requires research and group planning."

"The curriculum guide does not cater to the students who are performing below the grade level."

"Ways of teaching maths are not suggested in the curriculum document."

"Resources stated in the curriculum document are not provided at the school."

"The ratio of pupils to teacher poses a problem in addressing individual needs in the maths classes."

"Activities are limited and often unclear. The lessons and objectives are not set out in a systemic way e.g. geometry is scattered over the three terms. Suggested instructional materials are not provided by the

Ministry of Education."

Shulman (1986, 1987) and Ball, Hill and Bass (2005) highlighted the need for teachers to have not only the content knowledge and pedagogical knowledge skills for teaching the subject but also the curriculum knowledge for sourcing and using appropriate curriculum materials in the (mathematics) classes.

Teaching method

Even though 87% of the teachers in this study indicated that they varied their teaching strategies, it appeared that the focus was on getting the students to do the exercises in the manner that their teachers showed them. Some of the teachers' responses indicated that they experienced challenges in carrying out the recommendations that were made in the curriculum document for varying the teaching methods. The comments that were made included the following:

"The curriculum suggests more group work and project activities."

"Limited classroom space presents challenges for doing group work and other activities."

"Need on-going workshops to help to teach maths effectively." "Little is offered in the curriculum for the teaching of maths." "Too many concepts to cover."

"Large class size."

"Not enough resources to execute the lessons."

Classroom Learning Environment

For the category of *Classroom Learning Environment*, the percentages of positive opinions ranged from a low of 68% to a high of 97%. In this category, 97% of the teachers viewed themselves as making their students feel free to ask questions during mathematics classes, and 84% did not think that they got angry with their students when they were doing mathematics.

The percentages of teachers with positive responses on the items within this category varied between a low of 86% to a high of 97%. Eighty-six percent of the respondents indicated that they made sure that their students obeyed the rules and regulations of the mathematics classrooms and 97% indicated that they cared that their students respected them in the mathematics classes.

Assessment and feedback

Twenty seven per cent of the teachers indicated that they did not always give their students written tests to do to test how much mathematics they knew. However, 95% of the teachers indicated that they told their students how they were doing in mathematics, and 57% of the teachers indicated that they used different ways to assess their students.

The findings in this study indicated that the teachers mainly assessed their students' knowledge of mathematics by pencil-and paper (written) techniques. Some of the reasons that the participating teachers gave for their use of traditional methods are as follows:

"With large classes it is a whole lot more work in using different assessment tools."

"It is very difficult to assess students using different forms of assessment and therefore, paper and pencil test is mostly used."

"Class is too overcrowded and this hampers the teacher's ability to meet the students' needs in maths."

"It is difficult to find practical ways of assessing large class." "Difficult to assess the varying levels."

"Challenging finding suitable questions."

"Challenging having to assess so often – daily, monthly." "High student/teacher ratio."

It was evident that even though the teachers used the traditional methods for the reasons that they provided, they were aware that they should be varying the assessment techniques. They opined that

"Students with the lowest reading level reading skills should not be assessed in the same way that others who are independent readers are assessed. The same test could be done in different ways."

"Written tests are not always suitable for students who are working below the grade level. Other ways of testing have to be used example, interviews."

"Assessment activities have to be constantly modified to suit the level of the children."

Summary

The primary teachers' reflections of their classroom practices for implementing a (Grade 4) revised mathematics curriculum indicated that the teachers had high positive opinions on: (i) their personal attributes for teaching primary mathematics, (ii) their abilities to create classroom environments that were conducive to learning, and (iii) their abilities to manage and control their classes. There was room for improvement in the areas of planning and preparation, teaching method and assessment and feedback.

Research question 2

What are the common problems that the selected teachers indicate that they encounter in the teaching of Grade 4 mathematics?

The challenges that the teachers faced in teaching (Grade 4) mathematics related to five main areas as shown in Table 3: (i) availability (or non-availability) of resources; (ii) large classes; (iii) creating student-centered and activity-based mathematics lessons; (iv) completing the curriculum with many topics; and (v) facilitating learning by the students with diverse abilities, needs and competencies.

Twelve teachers had challenges teaching (Grade 4) mathematics without the necessary resources; ten teachers had challenges facilitating learning of the curricular content by students.

10 Conclusion

The findings indicate that the teachers were aware of their abilities and shortcomings to effectively deliver the mathematics curriculum. They were also aware of the challenges that negatively impact the quality of their teaching of mathematics.

The teachers continued to use traditional methods, and indicated that they lacked the knowledge and skills that are required to assess the various levels of competencies in the mathematics classrooms, as well as to select appropriate assessment tools for the slow learners, non-readers and low-level readers. These concur with the observations that Davis (2004) and Williams (2008) made about the use of inappropriate methodologies by teachers in Jamaican schools. Even though the research was conducted in Jamaica, these findings are likely to be applicable to teachers in other regions.

11 Tables

Table 1 : Profile of participants

Characteristics	Response option	Teachers	
		Number	%
Gender	Female	34	92
	Male	3	8
Age	20-29 years	7	19
	30-39 years	13	35
	over 40 years	15	41
	missing	2	5
Highest level of formal Education	Primary	0	0
	High School	0	0
	Teachers' College	13	35
	University	24	65

Highest qualification	Diploma	13	35
	BA	6	17
	BEd	13	35
	BSc	4	11
	Masters	1	2
Teaching experience	0-5 years	15	41
	6-10 years	12	32
	11-15 years	5	14
	16-20 years	2	5
	over 21 years	3	8

Table 2: Means and standard deviations for the scores on Section B of the teachers' questionnaire

Categories	n	Min	Max	Mean	SD
Planning and preparation	37	2.75	5.00	4.00	0.57
Teaching method	37	3.11	4.70	3.92	0.38
Classroom environment	37	3.25	5.00	4.39	0.48
Classroom management	37	3.75	5.00	4.57	0.40
Assessment and feedback	37	2.00	4.50	3.73	0.51
Personal attributes	37	3.33	5.00	4.67	0.44

Table 3: Frequency of teachers' responses on challenges they face in teaching Grade 4 mathematics

Responses	Frequency
Lack of resources/limited resources/resources that are recommended in the curriculum are not provided in the schools/unavailability of concrete instructional materials.	12
Large class sizes/high student:teacher ratio/overcrowded classes/lack of classroom spaces/lack of space for group work.	7
Creating student-centered classes/finding different strategies to use/motivating students/not enough time to build on students' knowledge/the curriculum does not give enough information for teaching/making the subject relevant to everyday life/finding ways to excite the students/ finding activities for group work and projects.	8
Too many concepts to cover/lack of remedial activities/computer not available for use.	6
Mixed-abilities of students/slow learners/ low levels of students/prerequisite knowledge and skills lacking in students/reasoning skills lacking in students/students are not motivated/students do not like the subject/assessment tools are inadequate/students are unable to read and understand the assessments given.	10

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