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COMMENTARY: PERSPECTIVES ON EDUCATION

NAVIGATING THE PATH BETWEEN THEORY AND PRACTICE IN MATHEMATICS INSTRUCTION: A PERSPECTIVE FROM THE EASTERN CARIBBEAN[1]

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Abstract: *In the Eastern Caribbean as elsewhere, there is concern about students' unsatisfactory performance in mathematics. At both primary and secondary levels, students continue to struggle. In this paper, I discuss factors that act as barriers between the theoretical knowledge that teachers of mathematics seem to possess and their classroom practice. I suggest that, despite the theoretical knowledge and their acknowledgement of the need for changes to their practice to meet the learning needs of their students, teachers of mathematics seem to be clinging to their "existing and long-standing schemas" (Skemp, 2006) which appear to be less effective in today's classrooms. I argue that for change to their pedagogy to be realized, teachers of mathematics in the region need extra guidance and support outside of initial teacher training, and continuous professional development opportunities if they are to see improvement in student achievement in the subject.*

Keywords: *Eastern Caribbean; mathematics education, teacher education, educational change*

INTRODUCTION

> *I recall many years ago reading an account of how to make a blouse with sleeves and a collar. You see, I had taken it into my head to make my own clothes, but after making several tops with cut-in cap sleeves and boat necks, I wanted to make something different. I borrowed a book from the library and I read the 'how-to' guide. When I was done, I thought I understood what to do. Even better, I could re-count what I had read and what I needed to do. Armed with this knowledge, I purchased my fabric and got to work. Suffice to say, I never wore that blouse. And for the rest of that phase of my life, I made*

[1] In this paper, 'Eastern Caribbean' refers to the geographical region which includes the nine countries that constitute the Organization of Eastern Caribbean States (Anguilla, Antigua and Barbuda, British Virgin Islands, Commonwealth of Dominica, Grenada, Montserrat, St. Kitts and Nevis, St. Lucia and St. Vincent and the Grenadines) and Barbados.

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blouses with cut-in cap sleeves and boat necks. My problem: I knew what to do in theory, but I had challenges putting it into practice.

This is a story that perhaps many others can tell; maybe not about making blouses, but some other activity. It may be easy to watch something being done, or to hear it being described and think, "I can do that"! But it is a different story to do it. Going from theory to practice is not easy. This is the dilemma that many of our teachers of mathematics may be facing as they enter the classroom: they may have a sense of what they should do; but may not be able to do it. In this paper, I draw on my experience as a mathematics educator and a teacher educator as well as on research conducted in the Eastern Caribbean, to discuss the status of mathematics teaching and learning in the region. I highlight some of the actions that were taken to help teachers to address the weak performance of students at all levels in this subject area and I proffer the notion that though these actions are sound and based on best practice in mathematics instruction, the benefits to the students are not realized because teachers of mathematics seem unable to translate theory in to practice with confidence. Finally, I make some suggestions for helping teachers of mathematics to use the knowledge of theories and best practices to which they are exposed in training and professional development activities to improve their instructional practices with a view to raising student achievement in the subject area.

MATHEMATICS TEACHING IN THE EASTERN CARIBBEAN: WHAT'S GOING ON?

As in other countries globally, in the Eastern Caribbean (EC) there is much concern about the performance and achievement of students in mathematics. There have been numerous complaints that students are exiting the different school levels with insufficient knowledge and skills in mathematics to experience success at the next level. For example, over the last ten years, there have been outcries in this sub-region of the Caribbean about the poor performance of students on the primary school exit examination, and though it appears that some improvement is seen periodically, national averages remain relatively low (OECS Secretariat, 2012). When I visit mathematics classrooms in primary schools, it is evident that many students continue to struggle with basic concepts of number and number operations such as place value, fractions, decimals, ratio and proportion; of geometry; and of measurement. Teachers of mathematics in secondary schools complain that students entering their classrooms from the primary level often have such poor understanding of basic concepts that the first term or two must be spent re-teaching these concepts, thus delaying the introduction of more advance concepts.

The story is no better at the secondary school level. Countries in this sub-region report declines in student achievement in mathematics at the Caribbean Secondary Education

Certificate (CSEC) level, the certification sought by students at the end of their secondary school years (e.g. OECS Secretariat, 2012; Renton, 2019) and of low pass rates (e.g. NOWGrenada, 2019). The trend for CSEC examinations in the region is that only a relatively small proportion of students who write the examinations are successful (Leacock, 2015), and usually, the majority of these obtain their pass at Grade 3, the lowest passing grade. Employers are concerned about the poor mathematics skills that school leavers are bringing with them to the workplace. Institutions of higher education are also concerned that applicants often lack the mathematics qualification for their programmes, or that the mathematics knowledge of those who hold passes in mathematics at the appropriate levels is not commensurate with their qualification. Indeed, in their study of the attitudes to mathematics among undergraduate Chemistry students at The University of the West Indies Cave Hill campus, Garner-O'Neal and Cumberbatch (2015) conclude that though students in the sample value mathematics, they lack self-confidence, motivation and enjoyment when it comes to doing the subject. This, these writers indicate, spills over into their performance in areas in Chemistry that rely highly on mathematics knowledge. It is evident, then, that in the sub-region, achievement in mathematics is not at the desired standard.

When students perform poorly in a subject area, it is common for all eyes to turn to those responsible for instructing those students: the teachers. So, let us consider the status of mathematics teaching and learning among teachers of mathematics in the region. First, it is worth saying that the teachers are products of the system to which they return to practise their craft. Consequently, for example, the weakness in mathematics achievement is also noticeable among applicants for the Associate Degree in Education (ADE), the initial teacher education qualification regulated by the Eastern Caribbean Joint Board of Teacher Education. Applicants for the Primary Education and Early Childhood Education programmes sometimes have their applications deferred to allow them to obtain the necessary qualification in mathematics. In addition, alternative pathways have had to be found to facilitate individuals in the programmes. For example, mathematics courses that are equivalent to the CSEC qualification and courses at a level even lower than this have been developed to create options to facilitate applicants and students who do not possess the regular mathematics qualification to be certified as teachers.

Recent research (Leacock, 2016) and classroom observations over the past ten years have further exposed some of the realities of teaching and learning mathematics in schools in the EC. For example, the research that was conducted in five of the countries found that about 58 percent of the teachers in the sample of primary school teachers had a pass at the CSEC level as their highest qualification in mathematics, with an additional 19 percent holding qualification at a higher level (Leacock, 2016). In interviews, teachers

in these primary schools admitted that though they had passes in mathematics, they did not understand what they had learned and that they did not feel comfortable teaching certain areas. Some indicated that they were still trying to pass CSEC mathematics after several tries. At the primary level, classroom teachers generally teach the core areas on the curriculum, including mathematics. At this level, another reality is also noticeable: many of the teachers are aware of best practices for teaching mathematics, but their weak content knowledge interferes with their ability to successfully implement these practices. What they know in theory is not reflected in their practice.

At the secondary level, 17 percent of the teachers of mathematics in the same research sample held a pass at the CSEC level as their highest qualifications in mathematics, with 78 percent holding qualifications at higher levels. This is to be expected since secondary schools usually hire teachers to teach specific content areas and those hired are expected to hold post-secondary school qualifications in the content area for which they are hired. The reality is, though, that holding a qualification in a content area does not equip an individual to teach. Pedagogical knowledge is also necessary, and the results of the study showed that only 64 percent of the teachers of mathematics at the secondary level were trained. Furthermore, from the classroom observations it was evident that even those who were trained had the tendency to "teach as they were taught". Indeed, some who had recently graduated from university lectured the students as they were lectured in their recent academic pursuits. In interviews with some of these teachers, especially those who had recently completed a programme of training, it was evident that they were aware of best practices, even though they were not implementing them effectively. When asked about this, teachers identified factors such as lack of support and insufficient resources as conditions that inhibit their implementation of the best practices for instruction to which they were exposed. Again, it appears that theory was not being translated into practice.

The fact is that over the years, there have always been concerns about the teaching and learning of mathematics in schools in the EC. Debates about issues such as what should be taught and how; rote memorization versus conceptual understanding; appropriateness of available textbooks; and reading literacy and mathematics, have surfaced over the years, and actions have been taken to address challenges that were identified through these debates. The intention is always to help the teachers of mathematics to improve the quality of their instruction and, by extension, the mathematics achievement of school children. In the next section, a summary of some of the actions taken will be given.

ADDRESSING THE CHALLENGES OF MATHEMATICS INSTRUCTION IN THE EC

Over the years, steps have been taken to address the challenges identified in mathematics classrooms. The debates about teaching and learning mathematics in the Caribbean have not gone unnoticed. Whenever perceived deficiencies in mathematics teaching and learning are identified, Ministries of Education may arrange for teachers to be trained or re-trained as deemed necessary. Teachers may be given the opportunity to be exposed to current best practices in professional development workshops and seminars; they learn about the underlying theories and philosophies on which the practices they are expected to adopt are built. Then they are sent back to the classroom to put it all into practice. What has been the outcome? Let us consider a few examples of this phenomenon.

There was a concern that mathematics instruction was made less effective by the **over-reliance on rote memorization**, the teaching of **procedures without understanding**, and the apparent **fragmentation of mathematics content**. In response, when national mathematics curricula were revised as part of the general curriculum reform undertaken by EC countries in the early 2000s, the reformed curricula adopted a constructivist philosophy that encouraged instructional strategies that actively engage the students in the learning process and that promote knowledge construction (e.g. Barbados Ministry of Education, Youth Affairs and Culture., 2000). Problem solving, problem-based learning and the use of technology to promote conceptual understanding and content integration were built into curricula and examples of best practices were provided for teachers. Yet, more than a decade later, changes to classroom practice remain insufficient to make the difference that is needed to improve student achievement in mathematics. Teachers of mathematics at both primary and secondary levels in the Eastern Caribbean reveal in formal and informal interviews that while they understand the notion of actively engaging the students and helping them to develop conceptual understanding of mathematics content, they did not feel confident and adequately prepared to do so.

Changes in classroom composition led to cries for help. For example, the expansion of universal secondary education (USE) in the English-speaking Caribbean meant that children who would not normally go to secondary school prior to USE, would now have to be accommodated in this setting (Leacock, 2009). Secondary school teachers of mathematics lamented their lack of training to adequately meet the needs of these children. To help teachers face these challenges, actions were taken not only to raise their awareness of current theories, but also to help them to use these theories to inform their practice. For example, a course on catering to students who struggle in secondary mathematics classrooms was included in the ADE programme for secondary school teachers of mathematics. It was designed to not only introduce them to current practices

in assessing students and diagnosing their needs, but also to expose the teachers to strategies for addressing students' difficulties, taking their strengths into account. Teachers who pursue the ADE training programme for secondary teachers of mathematics learn about the use of manipulatives and technology to enhance the learning experience for the students. Yet, classroom observations reveal that these resources are seldom used in secondary classrooms or not effectively used.

A further cause for concern for secondary school teachers of mathematics is that many of the students who are now entering their classrooms do not possess the **literacy skills** needed to understand mathematics concepts taught at this level. Indeed, teachers at both primary and secondary levels in the region note the weak literacy skills of students. But especially at the secondary level, many teachers did not think that it was their job as teachers of mathematics to teach reading and writing. A study carried out among teachers of mathematics in secondary schools in Barbados (Leacock & Warrican, 2006) found that 63 percent of the 172 participants felt that general reading difficulties contribute to the challenges that are experienced in mathematics classrooms, but only 27 percent of them reported addressing reading issues in their instructional practices. From the interview data for the study, it emerged that some of these teachers were adamant that teaching reading is the responsibility of English teachers. This view was also expressed by secondary school teachers of mathematics in other EC countries (Warrican & Leacock, 2007). But research in content area literacy suggests that subject matter teachers are the ones that are in the best position to teach students to read (comprehend) subject-related text (Shanahan & Shanahan, 2017). Indeed, not only reading but also writing should be incorporated in mathematics learning (Casa et al., 2017; Gallager, 2017).

In harmony with this best practice, a course on reading and writing across the curriculum was built into all the ADE programmes. In this course, teachers of mathematics, along with their peers in other subject areas, not only learn about theories relating to literacy across the various content areas, but they are also introduced to strategies that facilitate literacy development in mathematics classrooms. Conversations with teachers of mathematics in EC schools reveal that they possess knowledge of content area reading and writing, and that they understand the benefits of teaching students to use appropriate literacy strategies to develop conceptual understanding mathematics content. But classroom observations reveal limited use of these strategies by teachers and, by extension, their students. But for the most part, strategies for promoting literacy in mathematics classrooms are not widely seen in practice. There is still a heavy emphasis on teaching students how to answer specific questions to pass examinations and not enough on helping them to develop conceptual understanding that is transferrable to various contexts.

These are just a few examples of instances where the instructional practices of teachers seem out of sync with what they appear to know and, for the most part, can talk about. To me, these examples highlight teachers' challenge with translating the theory into classroom practice, and raise questions as to why it is so difficult for teachers to change their practice to reflect the knowledge that they have. This in turn leads to the question: how can teachers of mathematics be helped to move from theory to practice?

Bridging the Chasm between Theory and Practice

It seems to me that in the region, moving from theory to practice calls for teachers to make major changes and adjustments to the way they practise their craft. All the examples presented above involved teachers shifting from traditional pedagogy that may have been successful in the past, but that are no longer appropriate for students in the classroom today. What then are some of the barriers that inhibit teachers of mathematics from putting into practice the innovative instructional approaches to which they are often exposed? I believe it is linked to the educational history of the region, namely, the legacy of colonization. In 1963, Shirley Gordon presented us with a century of education in the region and shed light on the system that started in colonial times, survived the demise of colonialism, and persisted to our day. Other writers also highlight many current practices that are steeped in that period of occupation, and that are hard to replace (Thompson, Warrican & Leacock, 2011; Evans, 2001; Warrican, 2020). These include passive learners who revere everything that comes from the teacher's mouth; voiceless students; heavy reliance on "chalk and talk" or its modern-day equivalent, the powerpoint presentation; and, most of all, a strong examination culture. This latter feature of traditional education in the region is particularly troublesome.

The preoccupation with writing and passing examinations contributes greatly to teachers "teaching to the test", that is, focusing on procedural knowledge to answer anticipated questions at the expense of conceptual understanding. Skemp (2006), writing about teachers' affinity for procedural (instrumental) understanding over conceptual (relational) understanding, points out that this situation continues to exist because of, among other things, "[t]he great psychological difficulty for teachers of accommodating (re-structuring) their existing and long-standing schemas" (p. 93). Skemp is acknowledging that it is difficult for teachers of mathematics to change the way they think about teaching the subject. Teachers recognize that mathematics as a subject presents many challenges to students and in their zeal for examination success, maintain traditional pedagogies even though they acknowledge that these pedagogies may no longer be meeting the learning needs of students in general.

I remember a few years ago, sitting in a mathematics classroom in a secondary school first form where the teacher was having an algebra lesson. The students were working on an exercise that the teacher had given them when one bright-faced girl asked a question about one of the examples. I cannot recall what the question was, but I remember thinking that it was a particularly astute one and a great potential teachable moment for the teacher. I was particularly distressed when the teacher responded by telling the little girl that she should not worry about the concept about which she had asked because, in the teacher's words, "*you do not need that for CXC*[2]". During the post-observation discussion, the teacher was very articulate about constructivism and how it helps students to be actively engaged in constructing mathematics knowledge. It was evident that the teacher knew the theory, but it was not reflected in her practice, which was focused on passing examinations. This is just one example of teachers knowing the theory, but not putting it into practice.

Perhaps one insidious barrier to change in which teachers translate theory into practice is the emphasis on *teaching* mathematics rather than on *learning* mathematics. In my mind, the focus on teaching is linked to the traditional teacher-centred approach. Here, the aim of training and professional development for teachers of mathematics is to ensure that teachers know what to do when they are presenting content to their students. Even though we speak of student-centred instruction, teacher education for teachers of mathematics appears to be heavily teacher-centred. Can we as mathematics educators help teachers to explore how students learn mathematics, what should they be doing if they are to make sense of the mathematics we want them to learn? The *what* and *how* of teaching mathematics are both especially important and should not be trivialized. But the *why*, I believe, speaks to how students learn the subject content. To my mind, teachers of mathematics should engage with the subject as learners themselves for two reasons: (1) to improve their own understanding to the content that they are expected to help the students to learn, and (2) to deepen their understanding of and appreciation for the ways in which their students learn. Shulman (1987), in his much-cited work, links this to the concept of pedagogical content knowledge. He suggests that for teachers to be effective as subject area instructors, they should know what are key concepts that the learner must grasp and what can make it difficult for learners to grasp these concepts, but also "the processes of learning" (p. 19); that is how learners *learn* the content.

The question is, then, how can teachers be helped to change the way they think about the nature of mathematics and what it means to learn and teach mathematics? Or, with reference to Skemp's (2006) observation, how can we help them to re-structure their

[2] CXC is a regional reference to the Caribbean Secondary Education Certificate examinations written by students at the end of their secondary school years.

existing and long-standing schemas (p. 93) so that their teaching reflects the theories and best practices for helping them to learn mathematics?

Let me tell you a bit more about my clothes-making phase. It was sparked by the fact that my older sister had decided to take up dress making because she did not like the fashion of the day. Like me, she started with the cut-in cap sleeve, boat neck blouses and she too decided to learn how to make sleeves and collars. She too read about what to do, but she had more. She bought patterns; she practised cutting out sleeves and collars on paper before working with her fabric; she took a short course in dressmaking. But perhaps best of all she had expert support. We had an aunt who was a sought-after, respected seamstress and my sister worked closely with her. When she had to cut out sleeves and attach them to the blouse, she would sometimes do it under the watchful eye of our aunt. My sister would watch as our aunt demonstrated and gave tips for best results. Under such guidance, my sister became quite efficient at making tops with sleeves (long and short) and collars (including collars with piping of contrasting colours). With guidance and support, she was able to transfer into practice the theory to which we were both exposed. Without that level of assistance, I never moved beyond cut-in cap sleeves and boat neck blouses.

This true story of two sisters learning to sew is, I believe, a fine analogy for the situation that exists among teachers of mathematics in the EC today. They are exposed to the theories; they may even be afforded opportunity to practise while pursuing training. But if they are to go on to transfer theory into practice, they will need follow up guidance and support. I find it distressing that newly trained teachers are thrown into the classroom clutching their certificate and their whiteboard marker, and expected to put into practice all the creative ideas to which they were exposed during training. Quite often, though they may have theoretical knowledge and even some experience putting it into practice, it cannot be assumed that they are sufficiently competent and confident to implement what they learned in their practice.

Up to the point of certification, any practice that teachers-in-training may have had was done in controlled settings, with support from others such as their lecturers, cooperating teachers, and classmates. They are nurtured and encouraged in this setting, which helps them to develop confidence and skill. In contrast, newly trained teachers often enter or return to what I like to describe as hostile environments that may be characterized by absence of resources that they were trained to use, by unsupportive colleagues who protect their tried and true methods, and by school administrators who may not understand or support the innovative practices the newly trained teachers may want to

implement (Goodwin, 2012). In such environments, it would be easy for the newly trained teacher feel isolated, overwhelmed, and ineffective (Goodwin, 2012).

As was the case with me and the blouse-making episode, individuals tend to revert to what is easy, even if they know that it is not ideal or effective. In this final part of the paper, I will make some suggestions as to how teachers of mathematics, newly trained or experienced, primary or secondary, can be helped to not only be aware of best practices, but also become competent at translating the theory into practice.

I believe that the best way to help teachers of mathematics to resist the inclination to revert to the familiar and to translate their theoretical knowledge into practice is by providing them support and guidance. This is not a new or earth-shattering suggestion as many before have advocated for this (e.g. Tomlinson, 2012; Bieler, 2012). In an interview, Darling-Hammond, a contemporary respected advocate for teacher education, points out that without the necessary support from colleagues and school administration, newly trained teachers are likely to become discouraged and may leave the profession after only a short period (Scherer, 2012). Bearing in mind what was said earlier about the deep-seated influence of traditional approaches to mathematics instruction in the region, as well as the psychological challenge that teachers may face when required to re-structure these existing and long-standing schemas (Skemp, 2006), it is evident why guidance and support are necessary. This can come in many forms. For example, guidance and support for teachers of mathematics can come through coaching and mentoring (Grossman & Davis, 2012; Green, 2018); through communities of practice (Danielson, 2016; Ataizi, 2012; Mercieca, 2017); and through continuing professional development (Garcia & Weiss, 2019).

Research has shown that teachers who are supported when required to make a change are more likely to make a sustainable change (Burner, 2018). This suggests that if teachers of mathematics in the Eastern Caribbean are to break down those traditional existing and long-standing schema that influence their classroom instructional practices and replace them with practices that are informed by the theories and best practices to which they are exposed in their training, then guidance and support outside of initial training must be provided. The idea is for teachers of mathematics to participate in professional social groups where novice teachers or those who are expected to change their instructional practices interact with more experienced, more knowledgeable and skilled colleagues, learning from each other and capitalizing on each other's strengths.

Through these support systems, teachers can observe innovative strategies modelled and can themselves practise them in a safe, professional setting. They can receive feedback and suggestions for improvement before they get to the classroom. They can have any

misconceptions about the mathematics content cleared up so that they do not share incorrect concepts with their students. They can experience for themselves, the *learning* of mathematics that can guide their teaching of the subject. Being part of a community of trusted peers allows teachers to invite their colleagues to sit in their classroom to provide constructive feedback on their lessons. This kind of practical, hands-on support can be effective in helping teachers of mathematics to translate theory into practice.

CONCLUSION

The intent of this paper was to draw attention to the need for teachers of mathematics to be supported as they practise their craft in the classroom. Drawing on my experience and on research, I examined some of the concerns relating to student achievement in mathematics and some of the teacher-related actions that were taken and that continue to be taken to address these concerns. My underlying argument is that though the actions taken are worthwhile and expose teachers of mathematics to theories and best practices in mathematics instruction, not enough is done to help the teachers to translate the theory into practice. When we consider that these teachers are products of the same system in which the conditions that foster poor performance in mathematics exists, it should not be assumed that just providing training and exposure to best practices will lead to the changes in practice that are deemed necessary for student improvement.

Teachers need on-going guidance and support to hone their craft and to develop the confidence and skills. We must remember that breaking down "existing and long-standing schemas" of the traditional approach to teaching and learning that have been in place since the days of the colonizers of the region is a difficult task. This will take patience and time, but it is necessary. We should never allow our teachers of mathematics in the EC to become comfortable with cut-in cap sleeves and boat neck tops. We should never allow them to be comfortable knowing the theory but not able to translate it into practice – talking the talk without walking the walk. As mathematics educators and those with the authority to do so, we must find appropriate ways to provide the guidance and support to help our teachers to translate the theory to which they are exposed into effective classroom practice to the long-term benefit of students.

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