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SECONDARY MATHEMATICS TEACHERS' EXPLANATION OF FACTORS AFFECTING THEIR INSTRUCTIONAL PRACTICES

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Abstract: *Sound pedagogical practices have been shown to have profound positive effects on students' mathematics achievement. A fundamental aspect of these practices is the use of recommended teaching strategies. This paper reports Dominican secondary mathematics teachers' explanations of factors affecting their use of 12 strategies recommended for teaching mathematics. Data was collected and analyzed in two phases. In the first phase, 47 fourth and fifth form mathematics teachers were surveyed for their use of these 12 strategies. The data obtained from this survey was analysed quantitatively. A sample of six teachers surveyed participated in a focus group discussion in the second phase. The results of a thematic analysis of the focus group data provided explanations for the factors affecting Dominican secondary mathematics teachers' practices. Group participants articulated that most Dominican secondary mathematics teachers did not frequently use recommended strategies and, in some instances, misused these strategies.*

Keywords: *teaching strategy, mathematics achievement, teacher education, mathematics education*

INTRODUCTION

The effects of good teaching strategies are well documented in the literature (Davis & Renert, 2014; Watson & Harel, 2013; Baumert et al., 2010; Ma, 1999; D'Ambrosio et al., 1995; Even, 1993; Garofalo, 1989). Teaching strategies are methods and procedures used by teachers in their quest to help students develop into independent, strategic learners (Alberta Learning, 2002). In other words, the aim of using strategies in the teaching of mathematics is to allow students to independently select the most suited methods and procedures when confronted with a mathematics problem.

Furthermore, effective teaching strategies help motivate students and focus their attention, help students to organize information for remembering and understanding, and help learners to monitor and assess their learning. Put differently, effective teaching strategies place students in learning environments where they are encouraged to think and act creatively, take responsibility for their learning, and develop conceptual

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understanding. These can be achieved if students are exposed to a variety of instructional approaches, learning materials, appropriate support, and learning tools (Alberta Learning, 2002). These claims are in keeping with Even (1993), Baumert et al. (2010), and Watson and Harel (2013), who indicated that teachers' pedagogical content knowledge has the most significant impact on students' learning. Such a claim speaks to the significance of teachers' classroom actions and mandates a closer look at strategies employed in the teaching of mathematics. In the context of this study, 12 strategies recommended by D'Ambrosio et al. (1995) for the effective teaching of mathematics are reviewed and discussed.

D'Ambrosio et al. (1995) recommended that teachers should:

- *encourage exploration and investigation of mathematical ideas.* They should involve students in activities that help them construct mathematical understanding and investigate mathematical concepts. This idea was supported by Choike (2000) when he stated that teachers should involve students in "guided explorations; use learning-by-discovery teaching strategies" (p. 559). Such practices are critical for students to develop the skills to analyse, evaluate, and synthesize mathematical ideas.

- *use students' prior knowledge.* Students bring to the classroom different knowledge and experiences of the world, which affect the way they view and solve problems. An effective teaching strategy is to shape instruction that makes effective use of these experiences. This idea was also supported by Choike (2000), who called for lessons to be developed around the interests of students. He stated that teachers should "mould lessons, whenever possible, around the interests of individual students" (p. 560). Like D'Ambrosio et al. (1995), Choike believed that students were more likely to be motivated to learn the material when teaching and learning activities cater to their interests.

- *use manipulatives.* The proper use of manipulatives is essential to the understanding of new mathematical ideas. That is, the appropriate use of manipulatives helps students visualize mathematics concepts, and visualization is a key mathematics learning process. D'Ambrosio et al. (1995) recommended three stages in the use of manipulatives: the use of manipulatives alone in stage one, the use of the manipulatives together with paper-and-pencil representation in stage two, followed by symbolic representation alone in stage three. The second stage is critical, and adequate time must be spent during this stage if students are to make a successful transition from the concrete to more abstract forms of representation.

- *use culturally relevant materials.* This strategy helps to motivate students when mathematics is related to their different cultures and interests. Culturally relevant materials can be used as a springboard for instruction.

- *use real-world problem-solving activities*. Mathematics is a "lived" subject and relates to everyday experiences. Hence, students encounter mathematics daily, albeit in different forms and different places. Therefore, their interest in mathematics may be different. A useful teaching strategy is for teachers to connect mathematics to the real world, using a variety of problem-solving activities.

- *integrate mathematics with other content areas*. Just as in the case of using real-world problem-solving activities, this strategy helps students to apply knowledge gained to new situations. Such applications help make mathematics more meaningful and relevant.

- *use technology.* The use of technology is a highly recommended approach to teaching mathematics because of the many benefits it brings to the teaching and learning process. For instance, it can aid in the problem-solving process because it can be used to perform complex calculations quickly; it offers spreadsheets and graphing utilities; and it allows students and teachers to use powerful software such as Geometer's Sketchpad and Algebra Expresser among others. Furthermore, more time can be spent on the learning process and less on memorizing facts. Other studies (Resic & Besic, 2013; Resic & Cukle, 2013) support these claims.

- *use oral and written expression.* The process of explaining their thinking orally and in writing helps students better organize their thinking and solution strategies. It also helps them justify these strategies. This approach is supported by the National Council of Teachers of Mathematics (NCTM, 2000), who highlighted the importance of multiple representations in the teaching of mathematics.

- *encourage collaborative problem solving.* Working collaboratively holds many benefits for students. They share and negotiate meaning, refine and verbalize their understanding and that of their peers, provide constructive criticism, and are actively engage in learning. Sutton (1992) proposed five essential elements of cooperative classroom activities: (a) positive interdependence – students within groups are truly dependent on each other, (b) face-to-face interaction, (c) individual accountability – all students within a group are responsible for learning the material, (d) the appropriate use of interpersonal skills in the group must be taught, and (e) time must be given for students to analyse and evaluate how their group functioned.

- *use errors to enhance learning.* To say an answer is correct or incorrect is insufficient if students are to develop an understanding of mathematics. The thinking behind students' errors must be explored if misconceptions are to be "ironed" out and students be enabled to grow mathematically. Teachers should inquire into the processes used to find a solution, thus allowing students to refine and reorganize their thinking.

- *offer an enriched curriculum and challenging activities to all students.* All "normal" students' mathematics ability and critical thinking skills can be improved by exposing them to challenging mathematics experiences. These experiences must go beyond the routine and watered-down procedural tasks to experiences that allow them to explore and investigate mathematics concepts.

- *use a variety of problem-solving experiences.* Students must be exposed to a wide range of problems, including problems that can be solved in different ways, have more than one correct answer, involve decision making, and allow for different interpretations.

The above-listed strategies represent what D'Ambrosio et al. (1995) and others have put forward as some of the most significant in the teaching of mathematics. However, it would be remiss to end this section without noting the influence of textbooks on the strategies used in the teaching of mathematics. In a large cross-sectional study in the United States, Fan and Kaeley (1998) investigated the influence of textbooks in the secondary mathematics classroom and found that the textbooks used determined, to a large extent, the strategies employed by teachers. The study found that teachers tended to use the strategies emphasized in the textbooks regardless of their qualifications and years of experience. Therefore, care must be taken in selecting appropriate mathematics textbooks as a way of assisting teachers in employing effective teaching and learning strategies in the mathematics classroom.

While the effects of sound pedagogical practices are well documented in the literature, few studies investigating such practices were based in the Caribbean region, and none recorded to date was based in Dominica. Dominica is part of the global community, with scholars attending colleges and universities all over the world. Hence, the secondary mathematics experiences of Dominican students should form part of the grand narrative. More importantly, the mathematics classroom experiences of Dominican students should be evaluated against recommended practices so that necessary changes can be made. This study creates an opportunity for policymakers, teacher educators, and teachers to rethink and reshape their craft. It exposes some common teaching practices employed in Dominica's secondary mathematics classrooms.

Purpose of the Study

This article reports part of a wider study that I undertook between September 2014 and February 2015 to inform my MEd. thesis. The wider study investigated Dominican secondary mathematics teachers' explanations for any relationship between the performance of students in the Caribbean Secondary Education Certificate (CSEC) in mathematics, and teachers' mathematical knowledge, frequency in using the 12 recommended teaching strategies, and beliefs about the teaching of mathematics. The purpose of this article is to report the findings related to teachers' frequency in using the 12 recommended teaching strategies, paying attention to the factors that affected the use of these strategies.

METHODOLOGY

An explanatory sequential mixed methods design was used in this study. That is, a qualitative data collection and analysis phase followed an initial quantitative data collection and analysis phase (Cresswell, 2013). The result of the quantitative data was used to inform the data collection in the qualitative phase, thus, integrating both sets of data. However, priority was given to the qualitative results when answering the research question: *In what ways will Dominican secondary mathematics teachers explain the factors affecting how frequently they use 12 recommended teaching strategies?* According to Creswell (2013), explanatory sequential studies are used when a qualitative phase is needed to explain the findings from a quantitative phase. Creswell further argued that the priority given to the different phases is dependent on the researchers' aim and the purpose of the study. The purpose of this study is to provide teachers' explanations for factors that affected their use of 12 strategies recommended (D'Ambrosio et al., 1995) for the teaching of mathematics.

Quantitative methods

A quantitative survey was used to gather data to show the frequency of teachers' use of the 12 recommended teaching strategies. A survey was appropriate because it allowed the study to quickly gain information from most members of the targeted population (Ponto, 2015) that helped prepare for a focus group discussion used to answer the research question.

Participants. Participants were recruited from all 15 secondary schools in Dominica. All fourth and fifth form mathematics teachers were invited to participate. These people were targeted because they taught the bulk of the CSEC mathematics syllabus in Dominica. Lower secondary mathematics teachers were excluded from the study because

of the additional cost that their inclusion would have incurred. Moreover, their inclusion would not have significantly affected the result of the survey. Data was collected from participants between September and November of 2014.

Procedure. A paper-based questionnaire was used to collect data in this phase. The survey process started with an information letter and consent form sent to participants, through their principals, and ended with the collection of the completed questionnaire. Principals were asked to read the letter to their staff and display it in a conspicuous place at their school. The information letter discussed several key aspects of the study: targeted participants, purpose, procedure, benefits, risks, as well as confidentiality and anonymity issues. Attached to the information letter was also a consent form. This consent form, along with the information letter, aimed to assure targeted teachers that their participation in the study was completely voluntary. Approximately two weeks after the information letter was sent to schools, the survey forms (questionnaire) followed. These forms, one for each targeted teacher, were given to school principals for distribution to the relevant teachers. Participating teachers completed their form by filling in required sections and selecting appropriate answers from a list. The completed questionnaires were collected by the principals, who returned them to me. IBM SPSS statistics software (version 22) was used to analyse the data. Both frequencies and relevant percentages were determined and used in the analysis.

Instrument. This questionnaire was a modification of one developed and used by Simmt et al. (2013) in a similar but broader study conducted in Tanzania. Along with other information, the questionnaire was designed to collect participants' demographic information and their frequency in using 12 strategies recommended (D'Ambrosio et al., 1995) for teaching mathematics. The frequency of use of these strategies was measured on a six-point Likert-type scale ranging from zero to five, with a score of zero indicating that a strategy was never used and a score of five indicating that a strategy was used very frequently. Participants were also asked to indicate other strategies that they used in their classrooms that were not listed on the questionnaire.

Results. The results of the analysis are presented using two tables followed by narratives. Table 1 shows the participants' demographic information and helps to put their responses about their frequency in using the 12 recommended strategies in context.

Table 1
Surveyed participants' demographic information.

Factors	**Categories**	**Number of participants**		
		Male	Female	unstated
Age	Under 30 years	8	10	0
	30 – 49 years	8	13	2
	50 years and above	1	3	0
	Not stated	0	1	1
Training	Untrained		22	
	Trained		23	
	Not stated		2	
Experience teaching maths	5 years or less		10	
	6 – 10 years		19	
	More than 10 years		18	
Qualifications	Less than a first degree		24	
	First degree		16	
	Higher than a first degree		1	
	Not stated		6	

Forty-seven (N = 47) teachers participated in the survey. At least 57% (n = 27) of the respondents were female and at least 36% (n = 17) were male. Three participants did not disclose their gender. Fifty-seven percent (n = 27) of these teachers reported being above the age of 30 years, and approximately 49% (n = 23) reported being trained teachers; that is, they had completed a formal programme of study related to teaching. Furthermore, 79% (n = 37) of the participants reported having more than five years of experience teaching mathematics and 36% (n = 17) reported having a first degree or higher in the area of mathematics or mathematics education.

Table 2 presents participants' responses about their frequency in using the 12 recommended teaching strategies. Following is the interpretation of each integer value relating to the frequency of use: 0 = not at all; 1 = very infrequent; 2 = infrequent; 3 = somewhat frequent; 4 = frequent; and 5 = very frequent. NR indicates no response.

Table 2
Participants' reported frequency in using the 12 recommended strategies.

Strategies	Number of responses						
	0	**1**	**2**	**3**	**4**	**5**	**NR**
Exploration and investigations: involve students in activities where they explore and investigate mathematics ideas in and out of the classroom.	0	3	7	17	17	3	0
Use students' prior knowledge: build instructions around students' world experiences.	0	0	2	4	20	21	0
Use manipulatives and/or visual aids: Use physical objects, pictures, diagrams to help students make sense of mathematical concepts.	0	0	4	13	19	11	0
Use real-world problem-solving activities: link mathematics to the real world.	0	0	1	11	20	15	0
Integrate mathematics with other content areas: apply acquired knowledge to new situations found in other subject areas and/or vice versa.	0	1	4	15	21	6	0
Use technology: computer software, internet, interactive whiteboard, graphing calculators, etc.	3	8	8	17	8	1	2
Students use oral and written expression: students made to give explanations in oral and other forms such as writing, drawing, body actions, etc.	0	2	5	11	16	12	1
Encourage collaborative problem solving: meaningful small group activities.	0	2	2	8	24	11	0
Use errors to enhance learning: use students' incorrect responses to solicit students' misconceptions.	0	1	3	9	24	10	0
Offer an enriched curriculum and challenging activities. Expose **all** students to cognitively demanding tasks.	0	1	4	16	20	5	1
Use a variety of problem-solving experiences: problems that can be solved in different ways; problems with more than one correct answer; problems that may involve decision making; problems that allow for different interpretations.	0	2	7	13	17	8	0
Use culturally relevant materials: frame instruction in contexts related to students' interest: sports, arts, nature, cooking, etc.	0	2	6	16	19	3	1

Table 2 shows that participants reported using all 12 teaching strategies. The strategy of using real-world problem-solving activities scored the highest, with approximately 98% of the responses indicating that it was used "somewhat frequently" or "very frequently". The use of technology scored the lowest, with approximately 58% of the responses indicating that it was used "somewhat frequently" or very frequently. Moreover, participants' responses for ten (83%) of the strategies indicated an 80% or higher usage of "somewhat frequently" or "very frequently". These responses suggest that Dominican fourth and fifth forms mathematics teachers were regularly using these 12 recommended teaching strategies.

Qualitative methods

A focus group discussion was used to gather data to provide teachers' explanation of factors affecting their use of the 12 recommended strategies. A focus group discussion was chosen for several reasons. I felt that it provided for open and rich discussion as participants fed off each other's ideas. This argument is in line with Cortini et al. (2019), who asserted that "when the social origins are different it is better to choose a small group in order to have intentional knowledge and discussion" (p. 32). Furthermore, a small focus group was likely to increase the depth of the discussion (Cortini et al., 2019) by participants' sharing of personal experiences (Guest et al., 2017). A small focus group discussion also provided for easier data analysis (Cortini et al., 2019) and incurred minimal expense.

Participants. Six teachers participated in the focus group discussion. This group of teachers was recruited from the bigger body of fourth and fifth form mathematics teachers who participated in the survey. At the time of the survey, consent forms were given to teachers to indicate their interest in participating in the focus group discussion, and these forms were collected with the completed questionnaires. Over thirty teachers from twelve secondary schools indicated their interest. Twelve teachers were initially invited to participate in the discussion, using two selection criteria:

- one teacher from each of the twelve schools that showed interest was invited. I thought that having teachers from different schools, with different cultures, would provide for more diverse views and more intellectual conversations, and

- the heads of the mathematics department at the different schools were targeted. This was done to increase the chance that all participants would be knowledgeable about the teaching practices at their respective schools.

Of the 12 teachers who were invited, six responded positively. These six teachers constituted the focus group of five females and one male coming from six different

schools. All six teachers had over 10 years of experience teaching mathematics at the secondary school level, with one teacher having over 25 years of experience teaching mathematics at that level. Three of the teachers had B. Ed. degrees in secondary mathematics education, one had a BSc. in mathematics, one had a B. Ed. in secondary science education, and one had A-level mathematics as their highest qualification in mathematics. These teachers were exposed to a booklet used to focus the group discussion.

Instrument. A booklet containing the analysis of the quantitative data was given to each participant. It showed the frequency distribution for each strategy, along with a histogram. It also gave the mean and standard deviation associated with each strategy. These three points, followed by a leading question, were highlighted in the booklet:

1. The strategies investigated in the survey were all highly recommended by several researchers in the field of mathematics education, and these strategies are reported to have positive influences on students' mathematics performance.

2. The analysis of these strategies from the survey data shows that Dominican fourth and fifth forms teachers have frequently been using these strategies.

3. Despite the reported frequent use of these recommended strategies, Dominican secondary students continued to perform poorly in CSEC mathematics.

Question: Since our teachers have been using all these recommended teaching strategies with high frequency, how would you explain students' dismal CSEC mathematics performances over the years?

Data collection. The six participants and I met in a conference room where they sat around a large table facing each other. An audio recorder was placed at the centre of the table as the discussion began. The entire discussion lasted approximately two hours; however, the group spent approximately 45 minutes focusing on the 12 recommended strategies. The first 15 minutes of that 45-minute block were spent reviewing the analysed data from the survey relating to the 12 strategies. Each of the 12 strategies was considered individually with attention being paid to their mode, mean, and cumulative frequency. At that point we were only concerned with making sense of the analysed data. In the remaining 30 minutes of the 45-minute block, participants shared their views in response to the leading question presented in the booklet: Since our teachers have been using all these recommended teaching strategies with high frequency, how would you explain students' dismal CSEC mathematics performances over the years? Teachers were told that they could address the result of a specific strategy or any trend they identified in the analysed data. I moderated the discussion, ensuring that every teacher got an opportunity to share their views. I also requested clarifications from teachers and asked

follow-up questions based on their comments. Participants were also asked to speak to any other strategies that they or teachers at their schools employed in teaching mathematics.

Data Analysis. After the participants had expressed their views and their comments were transcribed, themes were identified. This analysis was undertaken in four stages (Taylor-Powel & Renner, 2003): (1) the recording of the focus group discussion was listened to in its entirety several times to get an overall impression of the content, (2) the recording was transcribed verbatim, (3) the transcription was read and themes were identified, (4) sections of the transcribed data were used to support the identified themes. Saldana's (2009) coding model was adapted and adopted in the third stage of the analysis process, which included five steps.

1. I identified key phrases from participants' comments that were transcribed.

2. From each phrase I identified the key terms in the participant's argument; for example, "time constraints", "teachers' knowledge", and "teachers' understanding".

3. These terms were then grouped based on similarity. For instance, "teachers' knowledge" and "teachers' understanding" fell into the same group.

4. A phrase was then used to label each group of terms; for instance, "awareness of strategy", "use of strategy", and "understanding of strategy".

5. Themes were then developed based on these new phrases, with attention paid to the participants' original transcribed phrases. The original phrases were used to maintain the gist of their arguments.

Results. Three themes were developed from the analysis of the focus group discussion. These themes are presented below and are supported by quotes from the focus group participants.

Theme 1: Teachers were aware of the recommended strategies but did not use them

Group participants said that they were aware that the twelve teaching strategies presented in the survey were all good strategies but admitted that they seldom used them because of many constraints. Participants cited constraints such as time, students' lacking the foundation from primary and lower secondary school, and students' behaviour. On the question of time, participants cited the pressures of preparing students to take the CSEC mathematics examination as limiting. Teachers claimed that using these strategies consumes much time that cannot be afforded in fourth and fifth forms. The following

quotes capture the essence of participants' contributions on the time constraints that they faced:

> I know I should be using them, but I also will have to admit we all know the constraints of teaching fourth and fifth forms CXC and how we are worried about the time… (*Teacher A, February 2015*).

> We also get very constrained about time when we get to fourth and fifth forms, and all of these do take more time I think we would agree… (*Teacher B, February 2015*).

The following quotes typify participants' views on the lack of foundation in the use of these strategies when students enter fourth and fifth forms:

> …but again, if we start teaching those things from the primary school level, then when it comes to the secondary it is not about teaching them how to think critically; now it is about them using their critical thinking skills to do what they have to do. So, it's gonna take less time…they are already used to it… (*Teacher D, February 2015*).

> …I think a lot of these strategies…if the students, especially the students, are not used to using them in primary school and first form, second form, third form, trying to get them to use investigation and exploration methods in fourth and fifth forms is more frustrating than anything else…(*Teacher E, February 2015*).

The constraint of student behaviour, as cited by group participants, was evident from comments such as this:

> …okay, but the real constraint is…you come to the classroom; you might have a perfect lesson; whatever happens a child might interrupt your introduction and at the back of your head you want to finish or…you might have a little issue on your mind and somebody throws you off…you just go back to your normal way of teaching… (*Teacher F, February 2015*).

Theme 2: Teachers use strategies inappropriately

Group participants expressed their belief that some teaching strategies are better suited to certain mathematics topics, and their use should be avoided in some topics. Participants explained, however, that some teachers used certain strategies in lessons to which they are not appropriately suited, thus rendering these strategies ineffective. Participants' views are expressed in the following quotes:

> …really and truly, they have the strategies;they are teaching it, but it is not reaching the students, and you wonder…some strategies are to be used for certain topics, and you have to use the strategy that can best fit the topic…some teachers they…like they have a small bowl of strategies, so you just pick one, and you just put it in the lesson… (*Teacher B, February 2015*).

> …but sometimes you just choose any strategy, and you just use it, and sometimes it just makes a mess of the lesson… (*Teacher D, February 2015*).

Participants said that, in some cases, teachers do not execute the strategies appropriately. Reference was made to a discovery lesson followed by a reference to the strategy of using students' errors:

> …you want to do a discovery lesson, but then you know the time comes when they keep on rushing the students…all the time…we need to get this and we need to get…and then after a while they maybe find it's taking too long trying to help them, little clues and whatever… (*Teacher C, February 2015*).

> …a student may answer a question, the response may be correct or wrong, and right away as teachers we respond and say "very good" or "correct". We don't give another student a chance to be able to look at that answer, say whether it is correct, what is wrong with that answer, if it is wrong…instead we as teachers are coming in too quickly, giving answers…(*Teacher F, February 2015*).

Theme 3: Teachers did not have a full understanding of the meaning of some strategies.

It was the consensus of group participants that some teachers did not fully understand the true meaning and significance of some of the teaching strategies given in the survey. Group participants said that teaching strategies such as using a variety of questions, using students' errors, open-ended versus closed-ended questions, and use of technology are some strategies that were possibly misinterpreted by survey participants. Group participants had this to say:

> …you know the famous PowerPoint presentations. So many of us may want to do PowerPoint presentations; but all we do is just place it on the screen and run through the slides, and we don't get the students to interact, and we are okay. That is supposed to be done under the use of technology, but it is not being used effectively… (*Teacher D, February 2015*).

> …use a variety of problems…are you sure the teachers didn't think of the questions in the math textbook…like simple little problems? (*Teacher B, February 2015*).

> …like, for example, that one with students' errors. If a child makes a simple mistake and I just say…Jane, that is not the answer the teacher probably saying… yes…I point out errors in the classroom…and then like when you think about problem solving and problems; most of the questions you give are closed-ended problems…we really don't give our students open-ended problems for them to come up with myriad ways to solve them… (*Teacher B, February 2015*).

One participant said that it is because Dominican teachers:

> …lack reflection; we don't…we don't do enough reflection; so probably that questionnaire was the first time teachers were thinking back…I don't think we do that enough. So given the opportunity to evaluate our teaching strategies…we think we do more than we actually do… (*Teacher E, February 2015*).

DISCUSSION

The themes presented above provide some insights into Dominican secondary mathematics teachers' thinking about factors affecting their use of 12 strategies recommended for teaching mathematics. The focus group participants contended that teachers were aware of recommended teaching strategies, but either did not use them or misused them. They also contended that some teachers did not have a full understanding of the meaning of some of the recommended teaching strategies; hence, some of the reports they offered regarding frequency of use were misguided. These arguments suggest that the ways that Dominican secondary mathematics teachers were exposed to these teaching strategies might have left them wanting.

Teachers' awareness of multiple strategies recommended for the teaching of mathematics is necessary if they are to cater to the diverse needs of students, and Dominican secondary mathematics teachers appeared to be well informed about many such strategies. With such awareness, teachers should be able to better plan lessons that cater to diverse backgrounds, interests, and needs (e.g., learning style) that students bring to the classroom. According to Li and Ma (2010), inquiry-based learning strategies that involve students' exploration with the use of concrete materials and technology were effective in improving the achievement of diverse learners. Dominica, while small, has a diverse population comprising people with different cultures (Kalinago/indigenous, African descendants), different socio-economic backgrounds (rural, urban, rich, middle-class, poor) and career goals. Students from these different groups attend the same schools and are taught in the same classrooms. Thus, it is imperative that teachers in Dominica employ multiple strategies to cater to all groups of students. Teachers' awareness of such strategies is necessary before they can be implemented in the classroom. Dominican fourth and fifth form mathematics teachers appeared to be well-

positioned in their awareness of strategies recommended for teaching mathematics. However, awareness alone is not enough to positively influence student learning.

While being aware of recommended strategies is important, using them appropriately is more critical to student learning, and Dominican fourth and fifth form mathematics teachers appeared to be falling short in the appropriate use of such strategies. Take, for instance, the use of technology. Group participants spoke at length about the use of PowerPoint presentations. However, they made no mention of the use of spreadsheets and graphing utilities as they relate to problem solving, or software such as Geometer's Sketchpad, Algebra Expresser, and LOGO, which may be used to explore and investigate mathematical ideas (D'Ambrosio et al., 1995; Passey, 2012). The use of PowerPoint presentations is a trivial use of technology in a time when most Dominican youths have access to smart devices and the internet. Furthermore, software such as Geometer's Sketchpad, Desmos and many others can be accessed for free on the internet, which is available in most, if not all, Dominican schools. It is incumbent on teachers and school authorities to make better use of these readily available technologies because students may benefit from their use (Li & Ma, 2010).

Another strategy that is critical to student learning that was reported as misunderstood is the use of students' errors in teaching. The consensus was that in the survey teachers answered positively regarding this strategy because they pointed out to students when they were correct or wrong and may even have told students why their answers were wrong. Using students' errors, however, goes beyond these simple responses to include questioning students' thinking process (Boaler, 2015; NCTM, 2014). Both Boaler (2015) and NCTM (2014) argued that students' errors must be explored if misconceptions are to be ironed out and full understanding is to be attained. However, this strategy – using students' errors in teaching – is not appropriately used by many teachers. Many Dominican mathematics teachers avoid putting students in situations where they are likely to make mistakes. This behaviour might be reflecting a school culture that has existed for decades, in which students' mistakes are frowned upon, and correct answers are glorified. Such behaviour, however, is contrary to what mathematics educators are now encouraging teachers to do. Teachers are encouraged to put students in situations that force them to make mistakes because mistakes help the brain to grow (Boaler, 2015). That is, besides pointing out students' errors, Dominican secondary mathematics teachers might consider exposing students to strategies in which they might make mistakes and work towards correcting them.

Deficiencies were exposed in the reported use of other strategies, such as offering an enriched curriculum and challenging activities to all students, in using a variety of problem-solving experiences, and in the use of manipulatives. Group participants stated

that they did not offer open-ended problems to their students, catered only for a select few, and questioned the use of manipulatives in upper secondary classrooms. One explanation given was that some teachers might not have fully understood some of the 12 strategies. Considering this argument, it would be interesting to know how Dominican secondary mathematics teachers became aware of these teaching strategies. At the time of the study, only 49% of the participants reported being trained teachers. These were likely exposed to these strategies through a prolonged programme of study in which they had time to practice them. Other participants may have become aware of these strategies during summer workshops that are held by the Ministry of Education in Dominica every year, or during in-service workshops or departmental discussions at their schools. In these cases, teachers' exposure to these strategies might have been limited, and follow-up to these workshops and discussions is rare. Thus, teachers may have acquired a knowledge of some of these 12 strategies recommended for teaching mathematics, but may not have developed a full understanding or adequate expertise in using them.

CONCLUSION

This article reported part of the findings of a wider study. It provides some Dominican teachers' explanations of factors affecting their use of 12 strategies recommended for teaching mathematics. Mixed methods were used to analyse the data. Results of the analysis indicate that Dominican fourth and fifth form teachers were aware of the 12 strategies investigated in the study, but either did not frequently use them or used them poorly. One possible reason given was that some teachers did not fully understand some of these strategies. If such is the case, then teacher educators, school administrators, and the Ministry of Education planners need to re-examine the ways that Dominican teachers are exposed to such strategies.

It would be interesting to investigate the role that concept study (Davis & Renert, 2014) could play in helping teachers develop a better understanding of these teaching strategies. According to Davis and Renert (2014), concept study involves groups of teachers meeting as communities of practitioners to study the teaching of mathematics concepts of common interest. This practice has the potential of helping teachers, especially in-service teachers, to broaden their knowledge and understanding of strategies that are recommended for teaching mathematics. Research into the influence of concept study on Dominican secondary teachers' use of strategies recommended for teaching mathematics could be a useful next step to this study.

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